5.0 Environmental Consequences

This chapter describes the potential environmental consequences associated with the future land-use alternatives (including the No-Action Alternative) discussed in Chapter 3. These analyses focus on the environmental resource categories described in Chapter 4, "Affected Environment."

5.1 Analysis Approach

The alternatives developed by U.S. Department of Energy (DOE) and the cooperating agencies and consulting Tribal governments would allow a range of uses for Hanford Site lands. These land uses would have impacts to natural and cultural resources and could affect the socioeconomic environment in the region surrounding the Hanford Site. The potential environmental impacts of each land use would depend on the nature of the use, its location with respect to the resources, and the amount of land affected by the land use. Because the location and scale of specific future uses (e.g., a sand and gravel quarry or a metal fabrication plant) cannot be readily predicted, the impacts of these uses on specific resources cannot be accurately quantified. As described in Chapter 6, impacts of specific projects would be analyzed under the *National Environmental Policy Act of 1969* (NEPA); NEPA-integrated *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and *Resource Conservation and Recovery Act of 1976* (RCRA) documentation; and, where applicable, local *State Environmental Policy Act of 1971* (SEPA) processes as part of the implementation of the Hanford Comprehensive Land-Use Plan (CLUP).

Question #18 of the Council on Environmental Quality's (CEQ) "40 Most Asked Questions" (46 FR 18026) provides guidance regarding the uncertain effects of future actions (see text box, *"CEQ's 40 Most Asked Questions: Uncertainties About Future Actions"*). The analysis in this chapter was based on the CEQ guidance and focuses on identifying and describing the impacts of reasonably foreseeable future uses in light of land-use trends in the Hanford region. For some land uses, information was readily available on possible development plans. For example, the Wahluke 2000 Plan provided information on proposed agricultural development of the Wahluke Slope (Wahluke 2000 Committee 1992), and DOE's 1996 Strategic Plan (DOE-RL 1996b) provided information on proposed DOE development. For other uses, assumptions could be made on the basis of data available for trends in the region (e.g., industrial development in the Tri-Cities).

CEQ's 40 Most Asked Questions: Uncertainties About Future Actions

18.Q. How should uncertainties about indirect effects of a proposal be addressed, for example, in case of disposal of Federal lands, when the identity or plans of future landowners is unknown?

A. The EIS must identify all the indirect effects that are known and make a good faith effort to explain the effects that are not known but are "reasonably foreseeable" Section 1508.8(b). In the example, if there is total uncertainty about the identity of future land owners or the nature of future land uses, then of course, the agency is not required to engage in speculation or contemplation about their future plans. But, in the ordinary course of business, people do make judgments based upon reasonably foreseeable occurrences. It will often be possible to consider the likely purchasers and the development trends in that area or similar areas in recent years; or the likelihood that the land will be used for an energy project, shopping center, subdivision, farm, or factory. The agency has the responsibility to make an informed judgment, and to estimate future impacts on that basis, especially if trends are ascertainable or potential purchasers have made themselves known. The agency cannot ignore these uncertain but probable effects of its decisions.

Although the analysis in this chapter is necessarily more qualitative than quantitative, it has been designed to provide adequate information to support the decisions to be made and to allow for meaningful comparison of the alternatives. The following sections describe the methods used to identify, describe, and compare the impacts of the alternatives.

5.1.1 Geographic Information System Analysis

A geographic information system (GIS) was used to organize the environmental data and identify and quantify the resources potentially affected under each alternative. The following source documents were used to obtain this data.

- Draft *Hanford Site Biological Resources Management Plan* (BRMaP) (DOE-RL 1996c) for biological elements including salmonid spawning areas; hawk and eagle nesting, perching, and roosting sites; floodplains; wetlands; and plant communities of concern (BRMaP Levels I, II, III, and IV)

- Waste Information Data System (WIDS)

- Hanford Geographic Information System (HGIS)

- Draft *Hanford Cultural Resources Management Plan* (CRMP) (DOE RL 1999) for cultural resources, including pre-contact and post-contact sites

- *Site Evaluation Report for Candidate Basalt Quarry Sites* (BHI 1995c) for geologic resources (analysis of basalt outcrops only)

- *Hanford Site Groundwater Monitoring for Fiscal Year 1997* (PNNL 1997b)

- *Hanford Site Development Plan* (DOE-RL 1994a) and other area development plans (DOE-RL 1990a, and DOE-RL 1991a) for Site infrastructure, including buildings, roads, and utilities

- *Hanford Site Environmental Report* (PNNL 1997a).

The GIS system includes spatial data on the distribution of resources, habitats, and infrastructure and allows these elements to be mapped and quantified. The GIS system was also used to quantify the land areas under each land-use designation for each alternative. The land areas, in hectares, acres, square miles, and percent of total acreage, are presented in Table 3-3. By combining the data sets for the resource elements listed above and the land areas for each land-use designation, the amount of each resource element that could potentially be affected under a given land-use designation was quantified. The GIS data tabulated for BRMaP Levels II, III, and IV resources are further discussed in Section 5.2.3.

The GIS analysis has limitations for determining the impacts to a resource from future land uses. For example, although approximately 16,833 hectares (ha) (41,595 acres [ac]) of BRMaP Level III habitat fall under the Conservation (Mining) land-use designation under the Preferred Alternative, it cannot be assumed that all of this habitat would be impacted by mining. Future mining operations under this alternative could impact BRMaP Level III habitat, but the size of the impact area cannot be quantified at this time. What can be determined at this time is (1) those areas designated for Preservation would not be disturbed by mining in the future, and (2) the mineral resources that are there are committed for Preservation.

5.1.2 Identification of Key Resources, Unique Features, and Species and Habitats of Concern

The analysis of the alternatives was focused on resource elements that were identified as important to DOE, the cooperating agencies, affected Tribal governments, and members of the public. These elements were identified through public scoping, comments on the August 1996 *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan* (HRA-EIS) (DOE 1996), and discussions with representatives of cooperating agencies and

American Indian Tribes. Generally, the resource elements can be categorized as follows:

- **Key resources**, including surface water (e.g., the Columbia River), groundwater, economically viable geologic resources, and industrial infrastructure

- **Unique features**, including the White Bluffs, basalt outcrops, active and stabilized sand dunes and bergmounds and ripple marks created by the cataclysmic Pleistocene Missoula Floods, viewing locations, viewsheds, archaeological and historic sites, and areas of cultural and religious importance to American Indian Tribes

- **Species and habitats of concern**, including plant communities of concern, wildlife and wildlife habitat, aquatic species and habitat, wetlands, and biodiversity.

Plant communities of concern were identified using the classifications from BRMaP. These classifications associate different management actions (i.e., monitoring, impact assessment, mitigation, and preservation) with particular sets of biological resources. The BRMaP classifies Hanford Site biological resources into four levels of management concern (Figure 4-27), which can be summarized as follows:

- **Level I** biological resources are resources that require some level of status monitoring because of the recreational, commercial, or ecological role or previous protection status of the resources. Level I includes Washington State “Monitor 3" species (DOE-RL 1996c).

- **Level II** biological resources require consideration of potential adverse impacts from planned or unplanned Hanford Site actions for compliance with procedural and substantive laws such as NEPA, CERCLA, and the *Migratory Bird Treaty Act of 1918*. Mitigation of potential impacts by avoidance and/or minimization is appropriate for this level; however, additional mitigation actions are not required. Level II resources include Washington State Monitor 1 and 2 species and early successional habitats.

- **Level III** biological resources require mitigation because the resource is listed by the State of Washington; is a candidate for Federal or state listing; is a plant, fish, or wildlife species with unique or significant value; has a special administrative designation (e.g., the Fitzner/Eberhardt Arid Lands Ecology Reserve [ALE Reserve]); or is environmentally sensitive. When avoidance and minimization are not possible, or application of these measures still results in adverse residual impacts above a specified threshold value, mitigation by rectification and/or compensation is required. Maintenance of Level III resource values may prevent more restrictive and costly management prescriptions in the future. Level III resources include Washington State candidate and sensitive species, threatened and endangered species, Federal candidate species, wetlands and deep-water habitats, and late-successional habitats.

- **Level IV** biological resources justify preservation as the primary management option because these resources are federally protected or have regional and national significance. The plant communities and habitats that are defined as belonging to this level are of such high quality and/or rarity that damages to these resources cannot be mitigated except through compensatory mitigation by acquiring and protecting in-kind resources. The legally protected species that are included in Level IV cannot be impacted without the concurrence of the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service so these types of impacts do not jeopardize the continued existence of the species. Level IV resources include Federal threatened and endangered species and those species proposed for listing, rare habitats such as the White Bluffs, active and stabilized sand dunes, and basalt outcrops.

The analysis of impacts to biological resources included an evaluation of effects on BRMaP Levels II, III, and IV plant communities.

5.1.3 Description of Impacting Activities

The nine land-use designations used to develop the alternatives discussed in Chapter 3 are each unique in defining allowable future uses. However, impacts to resources would be similar for several land-use designations. For example, the Industrial, Industrial-Exclusive, Research and Development, and High-Intensity Recreation land-use designations would each involve siting and construction of facilities with surface disturbance, increased traffic, and other similar impacts. Therefore, to simplify the analysis, the possible impacts under the nine land-use designations were organized into five impacting activities, defined as follows:

- **Mining**, including removal of vegetation, surface and subsurface disturbance, changes in groundwater hydrology, and increased dust and noise generation under the Conservation (Mining) and Conservation (Mining and Grazing) land-use designations

- **Livestock grazing**, including changes to vegetation cover and plant species composition under the Conservation (Mining and Grazing) land-use designation

- **Cultivated agriculture**, including removal of vegetation, surface disturbance (e.g., soil tillage), use of agricultural chemicals, increased water usage, changes to groundwater hydrology, and increased dust and noise generation under the Agriculture land-use designation

- **Development**, including removal of vegetation, surface disturbance, construction and operation of facilities, increased traffic, increased dust and noise generation, increased water usage, and changes in groundwater hydrology under the Industrial, Industrial-Exclusive, Research and Development, and High-Intensity Recreation land-use designations

- **Recreation**, including increased traffic and increased fishing, hunting, boating, bicycling, hiking, and picnicking, under the Low-Intensity Recreation, Conservation (Mining and Grazing), Conservation (Mining), and Preservation land-use designations.

These five impacting activities were used in the analysis to identify and describe, in general terms, the potential impacts to resource elements under each land-use designation.

5.1.4 Consideration of the Comprehensive Land-Use Plan Policies and Implementing Procedures

With the exception of the No-Action Alternative, impacts to resources from the activities described above likely would be mitigated through the application of the CLUP policies and implementing procedures described in Chapter 6. For example, a Use Request involving a proposed sand and gravel quarry in an area designated for Conservation (Mining) would be subject to review as described in Section 6.4. After completing the review, DOE may deny the request or issue a conditional use permit with project modifications to avoid protected resources or to mitigate damages to those resources. For the purpose of this analysis, the impacts of the alternatives are compared without consideration of the possible mitigating effects of the CLUP policies and implementing procedures discussed in Chapter 6. This approach allows for clearer comparisons of the potential impacts from each alternative and does not take credit for policies and implementing procedures that are actually part of the alternatives (except the No-Action Alternative) and not fully developed or in place. The CLUP policies and implementing procedures

are discussed along with other possible mitigation measures under each resource section.

5.1.5 Identification of Impacted Resources

The potential environmental impacts of proposed land-use designations under each alternative were evaluated by comparing the locations of impacting activities under each alternative to the locations of key resources, unique features, and species and habitats of concern on the Hanford Site. This enabled the generation of tables showing which resource elements would be affected by impacting activities under each alternative. Tables found in Section 5.2 provide an overview of the potential environmental consequences of each alternative and allow for simple comparisons of the alternatives. The identification of the affected resource elements provides a focus for the discussion of impacts under each alternative.

5.1.6 Methods and Assumptions for Estimating Socioeconomic Impacts

The possible socioeconomic impacts of each alternative were analyzed by focusing on the possible opportunities for economic development posed by each alternative. This approach provides for meaningful comparison of the alternatives without attempting to predict specific impacts, such as changes in demand for housing, schools, or other services. These types of impacts are best assessed on a project-by-project basis, through the appropriate local planning processes.

The study area for this analysis was limited to Benton, Franklin, and Grant counties, including the cities of Kennewick, Pasco, Richland (the Tri-Cities), and West Richland which are most likely to be affected by land-use changes. The assumptions used for and the general socioeconomic effects of each land-use designation are discussed below.

5.1.6.1 Industrial. The potential socioeconomic impacts of the Industrial land-use designation were evaluated by comparing the amount of land available for industrial use under each alternative to the estimated land needs for future industrial development. The land needs for future private industrial development were estimated by the Benton County Planning Department by correlating industrial land needs with projected population growth (BCPD 1997). For the purpose of this analysis, it was assumed that future industrial land needs would be met using lands on the Hanford Site and not other lands in the study area that are currently zoned for industrial use.

Assumptions are that annual population growth in the study area would continue at a rate of 2 percent during the 50-year planning period. This growth rate was extrapolated from the Washington State Office of Financial Management “medium series” population projections for Benton County for the period between the years 2010 and 2020. This growth rate corresponds to a population increase of approximately 193,000 for Richland, West Richland, Kennewick, and Pasco. Using a factor of 6 ha (15 ac) per 1,000 population, the Benton County Planning Department estimated that approximately 1,200 ha (3,000 ac) would be needed for industrial development to support the population growth. This estimate was increased to 1,620 ha (4,050 ac) to account for interior roads, railroads, and utility corridors needed to support the industries. The amount of land designated for industrial use under each alternative was compared to the estimated need for 1,620 ha (4,050 ac).

The amount of land under the Industrial land-use designation for each alternative was correlated with potential employment levels using data on Tri-Cities industrial development compiled by the Benton County Planning Department. Possible levels of employment, expressed as ranges, were determined for each alternative using data on the percentage of lands under industrial zoning designations that are currently developed, and scaling factors similar to those described in Section 5.1.5.4 for the Research and Development land-use designation. The ranges of predicted employment levels used were less than 100 employees, 100 to 1,000

employees, and over 1,000 employees.

Because DOE has a continuing mission at the Hanford Site and because Site lands are under Federal ownership, the potential for future federally sponsored industrial projects also must be considered. These projects may include DOE activities for current or future missions, DOE-sponsored privatization efforts, interagency training facilities such as the Hazardous Materials Management and Emergency Response Facility (HAMMER) Training and Education Center, or projects sponsored by other agencies. Because the land needs for future Federal projects are not currently known, the alternatives cannot be evaluated to determine whether they would meet these needs. Therefore, the alternatives are evaluated and compared based on the amount of land available to support DOE's mission or for other federally sponsored industrial development, over and above the estimated need projected by the Benton County Planning Department for private industrial development.

5.1.6.2 Industrial-Exclusive. The Industrial-Exclusive land-use designation applies to the Central Plateau, where DOE would continue waste management activities. Although all the alternatives being considered would accommodate current waste management activities, the alternatives differ in the amount of acreage available for future waste management activities. The extent to which these differences would affect future development and the resulting economic impacts are discussed.

5.1.6.3 Agricultural. The impacts of the Agricultural land-use designation were evaluated based on the increase in land available for agriculture use, as a percentage of total agricultural land in Benton, Franklin, and Grant counties. The increase in land available was correlated to increased sales of agricultural products. These correlations were made using data from the Census of Agriculture (USDA-NASS 1992), and the Benton County Agricultural Extension Office (Watson et al. 1991), and did not consider impacts on prices due to scales of economy or market share.

Although it is impossible to predict any commodity market over the next 50 years, the markets for apples, potatoes, and wheat are currently soft. For example, an estimated 105 million 42-pound boxes of apples were picked In 1998, whereas in an average year, such as 1997, about 78 million boxes were picked. Currently there is a market for only 80 to 90 million boxes, and Washington apple growers are faced with the option of leaving apples unpicked, reducing orchards, or paying for increased marketing in an attempt to gain market share (TCH 1998a) (see Table 3-2).

Three scenarios for agricultural development on the Wahluke Slope were identified, as follows:

- **Scenario 1** -- All lands under the Agricultural land-use designation, except those lands in the Bureau of Reclamation's (BoR's) Red Zone, would be used to produce a mix of crops similar to those currently produced in the three-county study area, and lands in the Red Zone would be used for grazing.

- **Scenario 2** -- All lands under the Agricultural land-use designation, including those lands in the Red Zone, would be used to produce a mix of crops similar to those currently produced in the three-county study area.

- **Scenario 3** -- All lands under the Agricultural land-use designation, except those lands in the Red Zone, would be used to produce specialty crops such as irrigated vegetables and irrigated fruit orchards, and lands in the Red Zone would be used for grazing.

5.1.6.4 Research and Development. The Research and Development land-use designation

involves the siting of large-scale facilities in clusters or campus-like developments. Other research and development (R&D) facilities are similar to industrial development, such as the facilities located in the 300 Area. These types of R&D facilities are compatible with industrial land uses and are addressed in the Industrial land-use designation; however, in some cases, R&D facilities may require large safety zones or may require separation from other facilities to minimize noise, dust, or vibrational impacts. For these reasons, development on lands under the Research and Development land-use designation is assumed to occur at a lower density than for the Industrial land-use designation. Because R&D facilities often require large capital investments and provide relatively high salaries compared to other industries, the economic impacts could be significant.

The Research and Development land-use designation was evaluated by estimating potential employment levels that could be supported by the research and development land base under each alternative. This method, which was developed by the Benton County Planning Department, involved correlating acreage available for research and development uses with employment levels using data from existing research and development projects associated with the Hanford Site. These data include total acreage for each project, total square footage of facilities, and total number of employees (Table 5-1). The average square footage per employee and the average facility area-to-land area ratio shown in Table 5-1 were used to estimate employment levels that would be associated with the research and development land base under each alternative. Because of the uncertainties associated with predicting levels of future use and the wide ranges represented by the data shown in Table 5-1, predicted employment levels for Research and Development were represented as ranges, rather than as point estimates. The predicted employment levels under each alternative were predicted to fall within one of three ranges: up to 100 research and development employees, 100 to 300 research and development employees, and over 300 research and development employees.

5.1.6.5 High-Intensity Recreation. High-Intensity Recreation allows infrastructure development such as potable water systems, septic systems, irrigation systems, paved parking lots, and buildings to support the intended recreational or other seasonal activities. For the purposes of impact analysis, the Benton County Planning Department High-Intensity Recreation assumptions include establishment of the B Reactor Museum, a 27-hole golf course, and a destination resort with a 350-room hotel and conference center and a recreational vehicle/trailer park at Vernita Terrace, which is located near Vernita Bridge (BCPD 1997). The economic impacts of intensive recreational use were estimated using available data for recreational visitor days at Vernita Bridge, regional averages of recreational expenditures per visitor day, and data from golf courses in the study area. These data and their sources are presented in Table 5-2.

In other alternatives, the High-Intensity Recreation land-use designation may also include developed Tribal fishing sites. In the *Columbia River Treaty Access Fishing Sites Final Phase Two Evaluation Report and Finding of No Significant Impact/Environmental Assessment* (USACE 1995), in-lieu fishing sites (i.e., in-lieu fishing sites are provided by the Federal government to affected treaty Tribes “in-lieu” of their traditional sites that were covered by the Federal dam reservoirs) ranged from 21.6 ha to 0.36 ha (53.4 ac to 0.9 ac) and included paved or gravel parking lots, boat ramps, restrooms, drinking water, fish cleaning stations, net repair areas and fish drying sheds, and storage sheds.

Table 5-1. Calculation of Ratios for Estimating Employment Under the Research and Development Land-Use Designation.

Facility	Facility Area m^2 (ft^2)	No. of Employees	Facility Area per Employee m^2 (ft^2)	Total Land Area ha (ac)	Facility Area to Land Area Ratio
Environmental Molecular Sciences Laboratory	17,995 (199,940)	230	78 (870)	8 (20)	1:4
Laser Interferometer Gravitational Wave Observatory	561,519 (6,239,099)	20	28,076 (311,955)	594 (1,486)	1:10
Waste Sampling and Characterization Facility	1,293 (14,375)	65	20 (221)	0.4 (1)	1:3
Fast Flux Test Facility	101,025 (1,122,500)	700	144 (1,604)	3,164 (7,909)	1:307
Superconducting Magnetic Energy Storage Facility[a]	19,602 (217,800)	30	653 (7,260)	19 (207)	1:41
Average			5,794 (64,382)		1:73

[a] The Superconducting Magnetic Energy Storage Facility - Engineering Test Model is no longer being proposed for siting at the Hanford Site.

Table 5-2. Data Used to Estimate Recreational Impacts.

Data Category	Datum	Source
Recreational Use on the Columbia River and Wahluke Slope		
Total, Hanford Reach	50,000 visits per year	NPS 1994
Sport fishing	30,800 visits per year	
Other day use	19,200 visits per year	
Persons per vehicle	2.3	
Recreational User Expenditures (per person)		
Sport fishing	$39.06 per day	DOE et al. 1994
Overnight (used for RV park guests)	$35.38 per day	
Day use	$10.19 per day	
Golf Courses		
Number of golfers	150 per day	Phone survey of Tri-Cities golf courses, May 1997
Season	365 days/yr	
Expenditures per golfer	$25/day	

5.1.6.6 Low-Intensity Recreation. The Low-Intensity Recreation land-use designation would increase opportunities for recreational activities in the study area. The socioeconomic impacts of this land-use designation were evaluated using the data for sport fishing and day-use activities provided in Table 5-2. Low-Intensity Recreation allows little to no infrastructure development to

support the intended recreational activities.

5.1.6.7 Conservation (Mining and Grazing) and Conservation (Mining). Although the two Conservation land-use designations are focused on habitat and resource conservation, limited mining and commercial grazing, if permitted by DOE, would be allowed. The economic impact of commercial grazing was evaluated by correlating the increased land available to the increase in the number of cattle that could be supported over the current baseline. Conversion factors of 0.17 animal-unit-months (AUMs) per hectare (0.067 AUM/acre) and $12/AUM (1998 dollars) were used to estimate the economic impacts of grazing.

The economic effects of limited mining under the two Conservation land-use designations were not quantitatively evaluated because of the speculative nature of developing mineral and natural gas deposits and the lack of data on mining in the study area. The amount and location of lands designated for Conservation uses under each alternative could indirectly affect remediation costs by affecting the costs of obtaining geologic materials for constructing barriers over waste sites. These cost impacts are discussed for each alternative.

5.1.6.8 Preservation. The Preservation land-use designation is reasoned to have little direct impact, although indirect impacts may include improvements in the quality of life, new educational and research opportunities, and benefits associated with ecotourism.

5.1.7 Methodology for Evaluating Environmental Justice Impacts

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629), directs Federal agencies to consider environmental justice during the NEPA process, and to incorporate environmental justice as part of the agency mission. Federal agencies are specifically directed to identify and address disproportionately high and adverse human health or environmental effects of programs, policies, and activities on minority and low-income populations to the greatest extent practicable and permitted by law.

5.1.7.1 Definitions. The following definitions were used to identify potential environmental justice impacts.

- **Census block group**: An area defined for the purpose of monitoring census data that generally consists of between 250 and 550 housing units.

- **Minority population**: A group of people and/or communities experiencing common conditions of exposure or impact that consists of persons classified by the U.S. Bureau of the Census as Negro/Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-White persons, based on self-classification by the people according to the race with which they most closely identify. For purposes of analysis, minority populations are defined as those census tracts within the zone of impact where the percent minority population exceeds the percentage minority population within the entire zone of impact. Census tracts where the percent minority population exceeds 50 percent also are considered minority populations. In the case of migrant or dispersed populations, a minority population consists of a group that is greater than 50 percent minority.

- **Low-income community**: An area where the median household income is at least 80 percent or more below the median household income for the metropolitan statistical area (urban) or county (rural). The 80 percent threshold was used based on definitions used by the U.S. Department of Housing and Urban Development.

- **Population base**: Census tracts were included in the analysis if 50 percent of the geographic area of the tract fell within the 80-kilometer (km) (50-mile [mi]) radius of the Hanford Site.

- **Disproportionately high and adverse human health effects**: Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal impacts to human health. Disproportionately high and adverse human health effects occur when the risk or rate for a minority population or low-income population from exposure to an environmental hazard significantly exceeds the risk or rate to the general population and, where available, to other appropriate comparison groups.

- **Disproportionately high and adverse environmental impacts**: An adverse environmental impact is an environmental impact determined to be unacceptable or above generally accepted norms. A disproportionately high impact refers to an impact (or risk of an impact) in a low-income or minority community that significantly exceeds the impact on the larger community.

5.1.7.2 Demographic Data. Demographic information obtained from the U.S. Bureau of Census was used to identify minority populations and low-income communities within an 80-km (50-mi) radius surrounding the 200 East Area on the Hanford Site at the census block group level (Neitzel et al. 1997). For the evaluation of environmental justice impacts, the area defined by this 80-km (50-mi) radius was considered the zone of potential impact.

Characterization of minority and low-income populations residing within a geographical area is sensitive to the basic definitions and assumptions used to identify those populations. Federal guidance on environmental justice with regard to the definition of an area that has a minority or low-income population large enough to act as a test for a disproportionate impact has not been developed. Consequently, the number of individuals identified as minority and/or low-income individuals within the population around a particular site may vary from analysis to analysis. Several different approaches to identification of minority and low-income populations have been used in recent DOE environmental impact statements (EISs). The approach presented in this Final HCP EIS is consistent with the approach used in the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Neitzel et al. 1997). Other demographic studies may use different assumptions and, consequently, report a different total population, minority population, or low-income population, depending on the assumptions used to identify each population.

5.2 Resource Impacts

The CLUP would consist of three parts: land-use maps, policies, and implementing procedures. Because of the mitigating influences of the policies and implementing procedures presented in Chapters 3 and 6, relying solely on the land-use map designation to determine impacts would be misleading. While the policies and implementing procedures in Chapter 6 provide a certain level of flexibility in Site development (e.g., Special Use Permits and Plan Amendments), resources would be managed and protected through the application of the policies and implementing procedures ensuring that future development would be orderly and reflective of the policies and implementing procedures limitations.

5.2.1 Geologic Resources

The Hanford Site includes geologic resources that are unique or have economic value. The unique features include the White Bluffs and basalt outcrops with their talus slopes, such as

Gable Mountain and Gable Butte; Missoula Floods features; and active and stabilized sand dunes, which have aesthetic, historic, and ecological value or are valuable for scientific study. Many of these features also have cultural resource value and are discussed in Section 5.2.4. Soils on the Hanford Site can also be considered to have ecological value. Key geologic resources include soil, sand and gravel, pea gravel, basalt, and natural gas deposits, which are needed to support remedial activities or have economic value for future development. Geologic materials required to support remediation at the Hanford Site are discussed further in Appendix D.

Impacts of the alternatives on unique geologic features on the Hanford Site are described in the following sections and summarized in Table 5-3. Impacts of the alternatives on the availability of key geologic resources are summarized in Table 5-4. The primary impacts to unique geologic features would occur from mining under the Conservation land-use designations. Development under the Industrial, Research and Development, and High-Intensity Recreation land-use designations could also result in destruction of unique features. Grazing is not anticipated to have impacts on these features, although overgrazing could result in increased erosion of some features.

5.2.1.1 No-Action Alternative. Under the No-Action Alternative, unique geologic features could be impacted by mining. Basalt outcrops could be developed as quarry sites for obtaining geologic materials for remediation although the CRMP would require extensive consultation that could result in stopping the proposed use. According to an engineering assessment (Appendix D), Gable Mountain and Gable Butte represent the most economic and technically feasible basalt sources available for remediation. In the absence of a land-use plan, features such as active and stabilized sand dunes and Missoula Floods features could be impacted by commercial sand and gravel operations. These features could also be impacted by industrial development. Soils on the Hanford Site could be impacted by mining, grazing, and cultivated agriculture, which would increase soil compaction and erosion. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation that could result in activation of sand dunes.

The No-Action Alternative would permit the commercial development of geologic resources on most of the Hanford Site, and would not restrict use of geologic resources needed to support remediation activities. The current administrative designations for the Saddle Mountain National Wildlife Refuge (NWR) and the Wahluke Slope do not preclude mining; in fact, some mining is occurring on those lands. The administrative designation for the ALE Reserve also would not preclude development of existing natural gas claims on the Reserve.

5.2.1.2 Preferred Alternative. Under the Preferred Alternative, unique geologic features, including Gable Mountain and Gable Butte, the White Bluffs, and the active sand dunes would be protected under the Preservation land-use designation. Missoula Floods features could be impacted by sand and gravel operations. Mining could result in soil compaction and increased erosion around quarry sites. Industrial development in the southeast portion of the Hanford Site could destroy dune stabilizing vegetation that could result in activation of the sand dunes.

The Preferred Alternative would not exclude the commercial development of existing natural gas claims on the ALE Reserve. However, the Preservation land-use designation for the areas of the ALE Reserve surrounding those claims would preclude construction of an access road to the claims, and could make future development costly.

Table 5-3. Potential Adverse Impacts of Land-Use Alternatives on Unique Geologic Features.

Alternative	Impacting Activity	Impacts to Unique Geologic Features (T = impact)[a]				
		Soils	Basalt Outcrops	White Bluffs	Missoula Floods Features	Sand Dunes
No-Action	Mining	**T**	**T**		**T**	**T**
	Livestock grazing	**T**				**T**
	Cultivated agriculture	**T**		**T**		
	Development				**T**	**T**
	Recreation					
Preferred Alternative	Mining	**T**			**T**	**T**
	Livestock grazing					
	Cultivated agriculture					
	Development					**T**
	Recreation					
Alternative One	Mining	**T**				**T**
	Livestock grazing					
	Cultivated agriculture					
	Development					**T**
	Recreation					
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development					
	Recreation					
Alternative Three	Mining	**T**			**T**	**T**
	Livestock grazing	**T**				
	Cultivated agriculture	**T**		**T**		
	Development				**T**	**T**
	Recreation					
Alternative Four	Mining	**T**				**T**
	Livestock grazing					
	Cultivated agriculture					
	Development					**T**
	Recreation					

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompanying text for significance of impacts.

Table 5-4. Opportunities for Geologic Resource Development Under the Alternatives.

Alternative	Development of Geologic Resources Allowed (T = yes)				
	Soil	Basalt	Pea Gravel	Sand and Gravel	Natural Gas
No-Action	T	T	T	T	T[a]
Preferred Alternative	T[b]	T[b]	T	T[b]	T[a]
Alternative One	T[b]	T[b]		T[b]	T[a]
Alternative Two					T[a]
Alternative Three	T	T	T	T	T[a]
Alternative Four	T[b]	T[b]		T[b]	T[a]

[a] Development of existing natural gas claims held by the Big Bend Alberta Mining Company could not be precluded under any alternative.

[b] Under this alternative, basalt, sand, and gravel resources could be quarried to support governmental purposes, and could not be commercially developed.

Although basalt quarrying would not be permitted at Gable Mountain or Gable Butte, other viable sources, such as the below-grade ALE Reserve quarry (located along State Highway 240), could be developed to provide geologic materials for remediation and construction supporting future DOE missions and other governmental purposes. However, development of these sources could result in higher remediation costs than quarries at Gable Mountain or Gable Butte (see Appendix D). Geologic resources on approximately 30 percent (44,183 ha [109,179 ac]) of Hanford lands would be available for commercial development under the Preferred Alternative; however, those geologic features that have unique characteristics could be excluded from development by the permitting process.

5.2.1.3 Alternative One. Under Alternative One, unique geologic features, including Gable Mountain and Gable Butte, the White Bluffs, Missoula Floods features, the active sand dunes and most of the stabilized sand dunes, would be protected under the Preservation land-use designation. Mining of geologic materials to support remediation could increase soil compaction and erosion around quarry sites.

Alternative One would allow mining in areas around the Laser Interferometer Gravitational-Wave Observatory (LIGO) and the Fast Flux Test Facility (FFTF), and in other scattered locations in the 100 and 600 Areas. Mining would be allowed in these areas to support Hanford Site remediation activities, future DOE missions, and other uses. As with the Preferred Alternative, Alternative One would allow commercial development of the existing natural gas claims on the ALE Reserve, but Alternative One would not allow any other commercial development of geologic resources.

5.2.1.4 Alternative Two. Under Alternative Two, unique geologic features (including Gable Mountain and Gable Butte, White Bluffs, Missoula Floods features, and active and stabilized sand dunes) would be protected under the Preservation land-use designation. This land-use designation would also minimize soil erosion by maintaining the existing vegetation cover.

As with the Preferred Alternative, Alternative Two would allow commercial development of the existing natural gas claims on the ALE Reserve. Alternative two would preclude the development of any other geologic resources on the Hanford Site. Geologic resources required to support remediation activities would have to be obtained from locations off the Hanford Site, which could increase remediation costs (see Appendix D).

5.2.1.5 Alternative Three. Under Alternative Three, unique geologic features could be impacted by mining. Basalt outcrops, including Gable Mountain and Gable Butte, could be developed as quarry sites for obtaining geologic materials for remediation, future DOE missions and other uses. Missoula Floods features and active and stabilized sand dunes could be impacted by sand and gravel quarrying. These features could also be impacted by industrial development in the southern and eastern portions of the Hanford Site. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation and may activate the sand dues. Mining and grazing under Alternative Three could result in soil compaction and increased soil erosion. Cultivated agriculture under Alternative Three would increase soil erosion through removal of the existing vegetation cover and tillage. Soil productivity could also decline with intensive cropping.

Alternative Three could result in increased landslide activity at White Bluffs by allowing agricultural development on the Wahluke Slope. Previous studies (discussed in the Hanford Reach EIS [NPS 1994]) suggest that irrigation of crops east of the White Bluffs has raised the local water table, saturating the sedimentary materials in the bluffs and increasing the instability of slopes along the Columbia River. Previous landslides at the White Bluffs have resulted in increased sediment loading to the Columbia River. New development of irrigated agriculture on the Wahluke Slope could contribute additional groundwater to the area, increasing slope instability and the potential for additional landslides.

Alternative Three would allow basalt quarrying, mining of sand and gravel and pea gravel resources, and development of natural gas deposits on the ALE Reserve. The Conservation land-use designation on the ALE Reserve would not preclude construction of an access road to existing natural gas claims. Under Alternative Three, geologic resources on approximately 53 percent (195,612 ha [483,368 ac])of Hanford lands would be available for commercial development; however, those geologic features that have unique characteristics could be excluded from development by the permitting process.

5.2.1.6 Alternative Four. Under Alternative Four, unique geologic features (including basalt outcrops, the White Bluffs, Missoula Floods features, and active and stabilized sand dunes) would be protected under the Preservation land-use designation. This land-use designation would also minimize soil erosion, although some soil compaction and increased soil erosion could occur as a result of mining geological materials for remediation. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation that could result in activation of sand dunes

As with the Preferred Alternative, Alternative Four would allow commercial development of the existing natural gas claims on the ALE Reserve. Alternative Four would not allow any other commercial development of geologic resources. Mining would be limited to basalt and sand and gravel quarries developed to support remediation activities at the Hanford Site. These quarries would be located in the south-central portion of the Site, in the areas designated as Conservation (Mining). Basalt quarrying would not be permitted at Gable Mountain or Gable Butte under this alternative, but the ALE Reserve quarry located along State Route 240 could be developed to provide geologic materials for remediation.

5.2.1.7 Mitigation Measures. Future development of and access to Hanford Site geologic resources would require review under the CLUP policies and implementing procedures described in Chapter 6. These procedures, which would be implemented under any of the alternatives being considered except the No-Action Alternative, would require avoidance or minimization of the impacts of mining or quarrying. Proposed mining or quarrying activities would be controlled through the issuance of special-use permits to be consistent with the CLUP policies and

implementing procedures requiring the protection of natural and cultural resources. Other mitigation measures that could reduce impacts to unique geologic features include the following:

- Researchers could be invited to make observations before and during excavation or mining of unique features such as Missoula Floods features so the scientific value of the features would not be lost.

- Efficient irrigation methods could be employed to minimize groundwater recharge in the area of the White Bluffs.

- Rotational grazing methods could be employed to minimize soil erosion.

- Conservation tillage, fallowing, and other techniques could be used to reduce soil erosion from croplands.

- Mining operations could be required to remove, stockpile, and replace topsoil.

- Soil stabilization techniques would be used around mining and development sites to contain wind erosion.

5.2.2 Water Resources

Key water resources at the Hanford Site include surface water and groundwater. The primary surface water feature is the Columbia River. Other surface water features include springs and seeps. Groundwater is found throughout the subsurface of the Hanford Site at depths ranging from approximately 250 meters (m) (820 feet [ft]) in the central portion of the Site to approximately 15 m (50 ft) near the Columbia River.

Surface water resources could be impacted by future land uses in several ways. Water quality could be degraded as a result of point source pollution from industrial waste water discharges and non-point source pollution from runoff. Future industrial development and R&D activities could increase waste water discharges to the Columbia River.

The Columbia River is classified as a “Class A” body of water by the State of Washington, which requires that permitted discharges of waste water from point sources to the river be as clean as, or cleaner, than the water in the river. Consequently, under normal circumstances, industrial discharges to the river would be unlikely to impact water quality in the river. Nevertheless, the potential for water quality impacts from new industrial activities must be considered because of the potential for inadvertent releases and permit violations. Contamination of groundwater from industrial development could also indirectly affect surface water through groundwater discharges to the Columbia River. Industrial development could also increase water withdrawals from the Columbia River.

Non-point source degradation of surface water could occur as a result of runoff of agricultural chemicals from cultivated fields or a golf course. Surface water could also be degraded through trampling of wetland vegetation by livestock congregating in the vicinity of the water during dry periods. Loss of this vegetation could lead to increased siltation and water quality degradation.

Impacts to groundwater could occur as a result of consumptive use or contamination. Consumptive use could lead to draw down of aquifers and could change local groundwater flow patterns. Groundwater flow could also be altered by infiltration of water used to irrigate crops under the Agriculture land-use designation. Infiltration from irrigation could also mobilize contaminants in the vadose zone and increase contamination of groundwater. Contamination

could occur as a result of infiltration of chemicals from spills. Groundwater contamination could also occur as a result of infiltration of agricultural chemicals applied to crops, landscaped areas, or golf courses.

Groundwater flow and contaminant transport models are used to simulate future groundwater-flow conditions and predict the migration of contaminants through the groundwater pathway. During the past several years, a Site-wide, three-dimensional, flow and transport model has been under development by Pacific Northwest National Laboratory's (PNNL's) Groundwater Monitoring Project.

Two-dimensional flow models have been used extensively at the Hanford Site. These models were generally adequate for predicting aquifer head changes and directions of groundwater flow prior to cessation of large wastewater-disposal operations because the groundwater levels were somewhat stable across the Hanford Site. However, in the early 1990s, it was recognized that a three-dimensional model was needed for accurate calculation of future aquifer head changes, directions of groundwater flow, mass transport, and predictions of contaminant concentrations. The three-dimensional model was needed because there is significant vertical heterogeneity in the unconfined aquifer, and the water table is dropping over most of the Hanford Site in response to cessation of large wastewater discharges. The unconfined aquifer system is composed of a series of conductive units that are separated from each other in most places by extensive mud units with relatively low hydraulic conductivities. Accounting for this vertical heterogeneity is particularly important as the water table drops, because the water table is currently near the contact between the Hanford formation and the underlying and much-less-conductive Ringold Formation over a large part of the Hanford Site. Dewatering of the highly permeable Hanford formation sediments in some areas (PNL-10196) may result in aquifer transmissivity changes. These changes would be an order of magnitude or more that would not be properly accounted for by two-dimensional flow and transport models.

The Site-wide, three-dimensional model was used during fiscal year 1998 to support the composite analysis for low-level waste disposal in the Hanford Site (PNNL-11800). The composite analysis involved simulation of future transport of radioactive contaminants that are expected to exist on the Hanford Site following site closure. Site closure was assumed to occur in the year 2050, followed by a 1,000-year compliance period. Only sources within a designated waste management area on the Central Plateau were considered because other potential sources are assumed to be remediated before site closure to the level that they would not pose a hazard. During the 1,000-year compliance period, potential exposure to radioactive contaminants outside the waste management area must be within regulatory limits and maintained "as low as reasonably achievable" (PNNL-11800). These future groundwater conditions would be potential impacts common to all alternatives and are shown as Figures 5-1 through 5-9, which include the following:

- Figure 5-1 -- Water Table Elevations Predicted for 2350 Compared to the Inferred 1944 Water Table
- Figure 5-2 -- Predicted Tritium Plume from the 200 Areas for 2050
- Figure 5-3 -- Predicted Iodine-129 Plume from the 200 Areas for 2049
- Figure 5-4 -- Predicted Technetium-99 Plume from the 200 Areas for 2049
- Figure 5-5 -- Predicted Uranium Plume from the 200 Areas for 2049
- Figure 5-6 -- Predicted Strontium-90 Plume from the 200 Areas for 2049

- Figure 5-7 -- Predicted Strontium-90 Plume from the 200 Areas for 2049
- Figure 5-8 -- Predicted Chlorine-36 Plume from the 200 Areas for 2049
- Figure 5-9 -- Predicted Selenium-79 Plume from the 200 Areas for 2049.

The potential for impacts to groundwater under each alternative is identified in Table 5-5, and the potential for impacts to surface water is identified in Table 5-6.

5.2.2.1 No-Action Alternative. Under the No-Action Alternative, mining operations could be undertaken within the All Other Areas geographic area and could occur in the vicinity of the Columbia River. Runoff from mining operations located close to the Columbia River could lead to water quality degradation because of erosion and release of silt to the river. Also, potential fuel or chemical spills on quarry sites could contaminate groundwater or surface water if the sites are located close to the Columbia River. Mining operations could also require water for material washing and dust control. Water use by mining operations would be minor compared to agricultural or industrial uses, and would be less likely to result in changes to groundwater hydrology. Quarry sites could collect surface water runoff, and provide a favorable infiltration surface thereby increasing recharge and mobilizing contaminants in the vadose zone below the quarry sites.

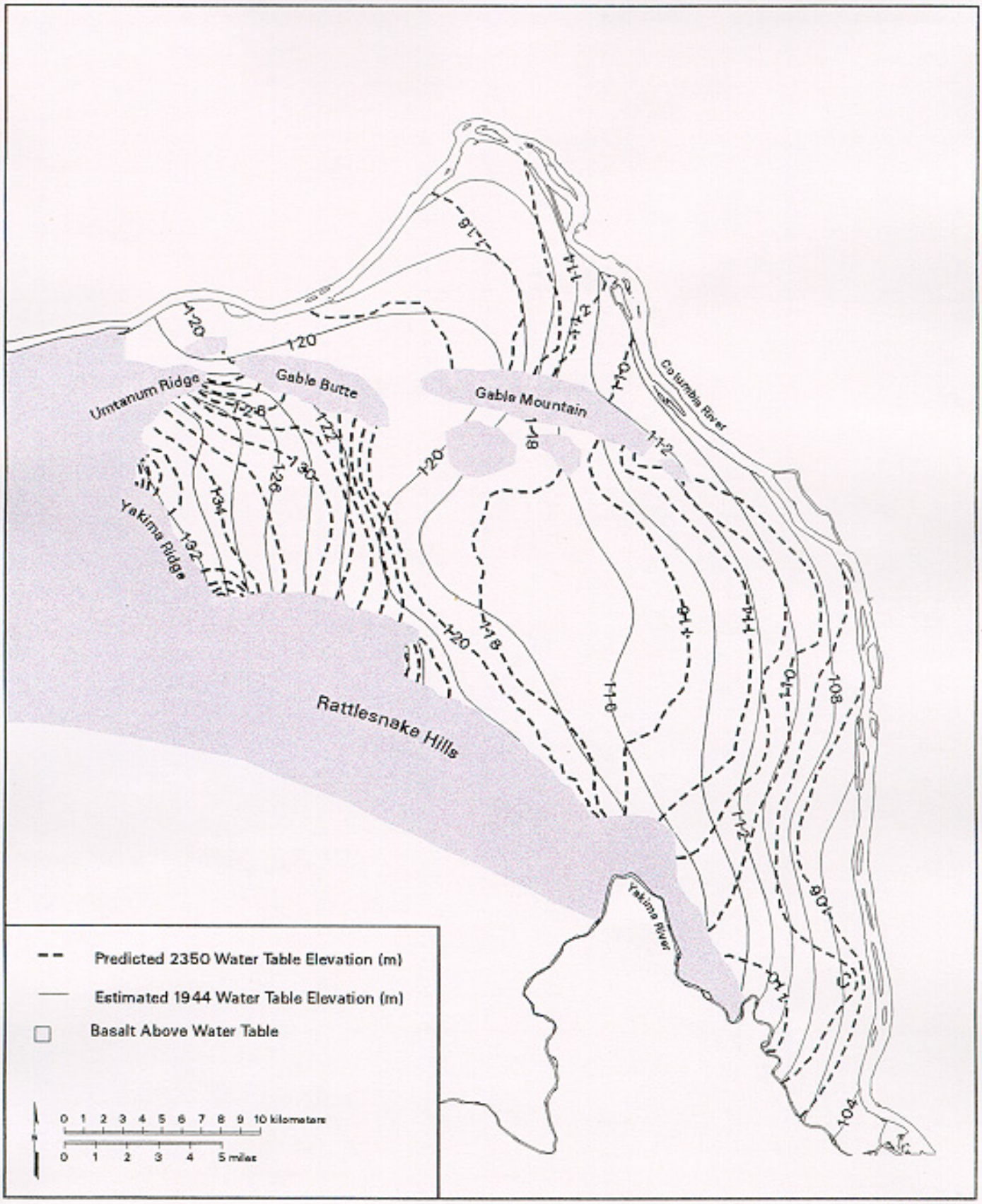
Grazing under the No-Action Alternative could occur in the vicinity of the Columbia River and could reduce riparian vegetation cover. Reduced cover could destabilize the river banks and increase sediment loading to the river. Grazing use under the No-Action Alternative would also require development of water sources. However, water consumption for grazing would be relatively small compared to other uses, such as agriculture or industrial development.

The No-Action Alternative could allow conversion of lands to cultivated agriculture in the All Other Areas geographic area. Agricultural development would most likely occur near the Columbia River, which would provide a clean source of irrigation water. Irrigation water could also be provided by groundwater wells, which would alter groundwater flow patterns through aquifer drawdown. Irrigation of crops could leach agricultural chemicals and residual Hanford Site contaminants from the vadose zone to the groundwater. Runoff from agricultural land could also degrade water quality in the Columbia River through release of agricultural chemicals and increased siltation.

The No-Action Alternative would allow industrial development throughout the All Other Areas geographic area. Future development would most likely occur in the South 600 Area because supporting infrastructure is available in this area. Water to support development could be obtained from on-site groundwater wells, as is the case in the 400 Area, provided by the City of Richland (as it is in the 300 Area), or withdrawn from the Columbia River. Consumptive use of groundwater to support development could lead to changes in groundwater flow patterns as a result of aquifer drawdown. Water quality degradation from new industrial point sources would be minimal because discharges (e.g., septic systems) to groundwater would require state or county permits, and because Federal permit discharges to the Columbia River must be as clean or cleaner than water in the river. However, water quality could be affected by accidental releases to the soil column or the Columbia River or Yakima River from industrial sites.

The No-Action Alternative would not increase recreational access to the Columbia River over existing conditions and, therefore, is unlikely to result in increased impacts to water quality from recreational activities.

Figure 5-1. Water Table Elevations Predicted for 2350 Compared to the Inferred 1944 Water Table.



pdt99013.eps

Figure 5-2. Predicted Tritium Plume from the 200 Areas for 2050.

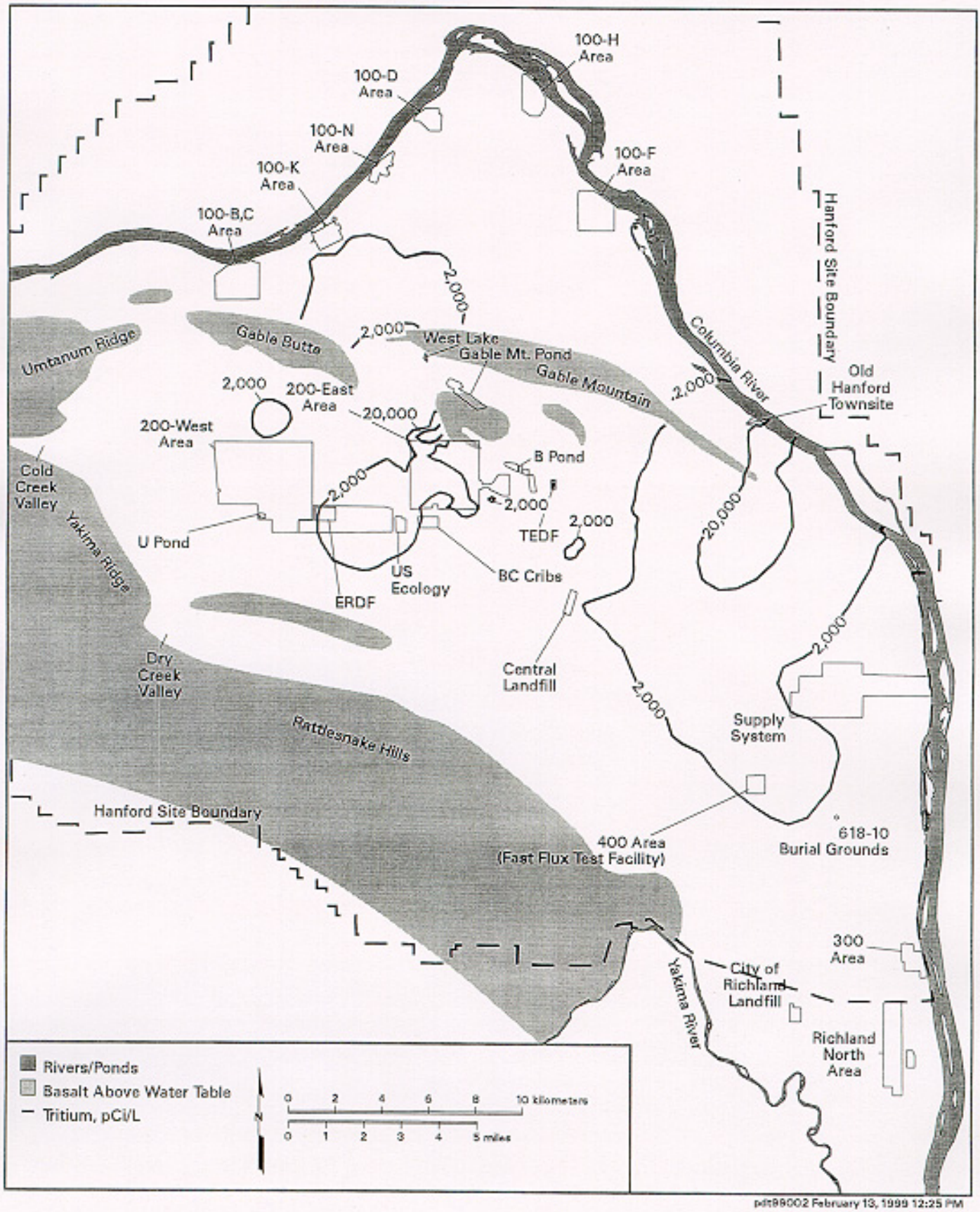


Figure 5-3. Predicted Iodine-129 Plume from the 200 Areas for 2049.

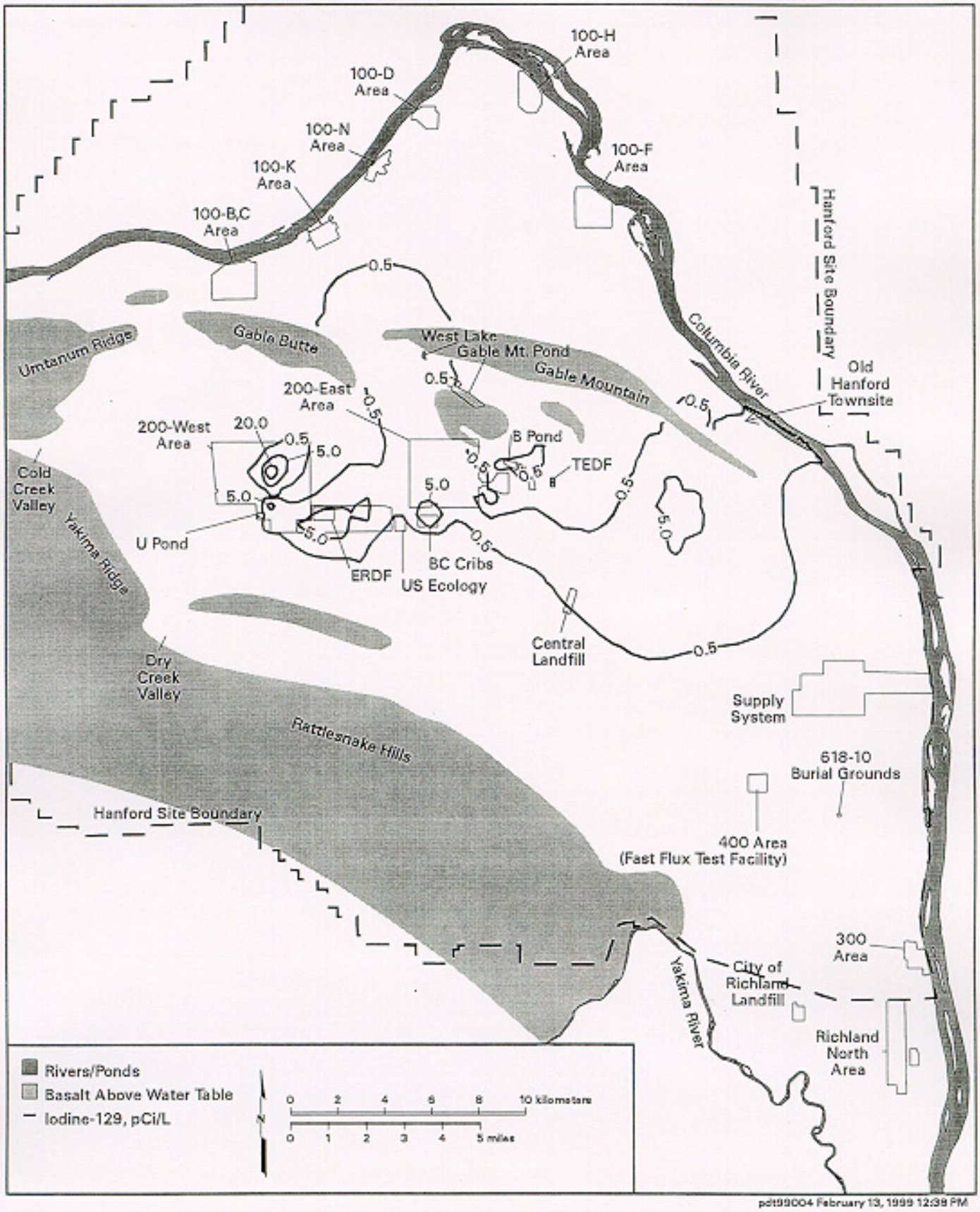


Figure 5-4. Predicted Technetium-99 Plume from the 200 Areas for 2049.

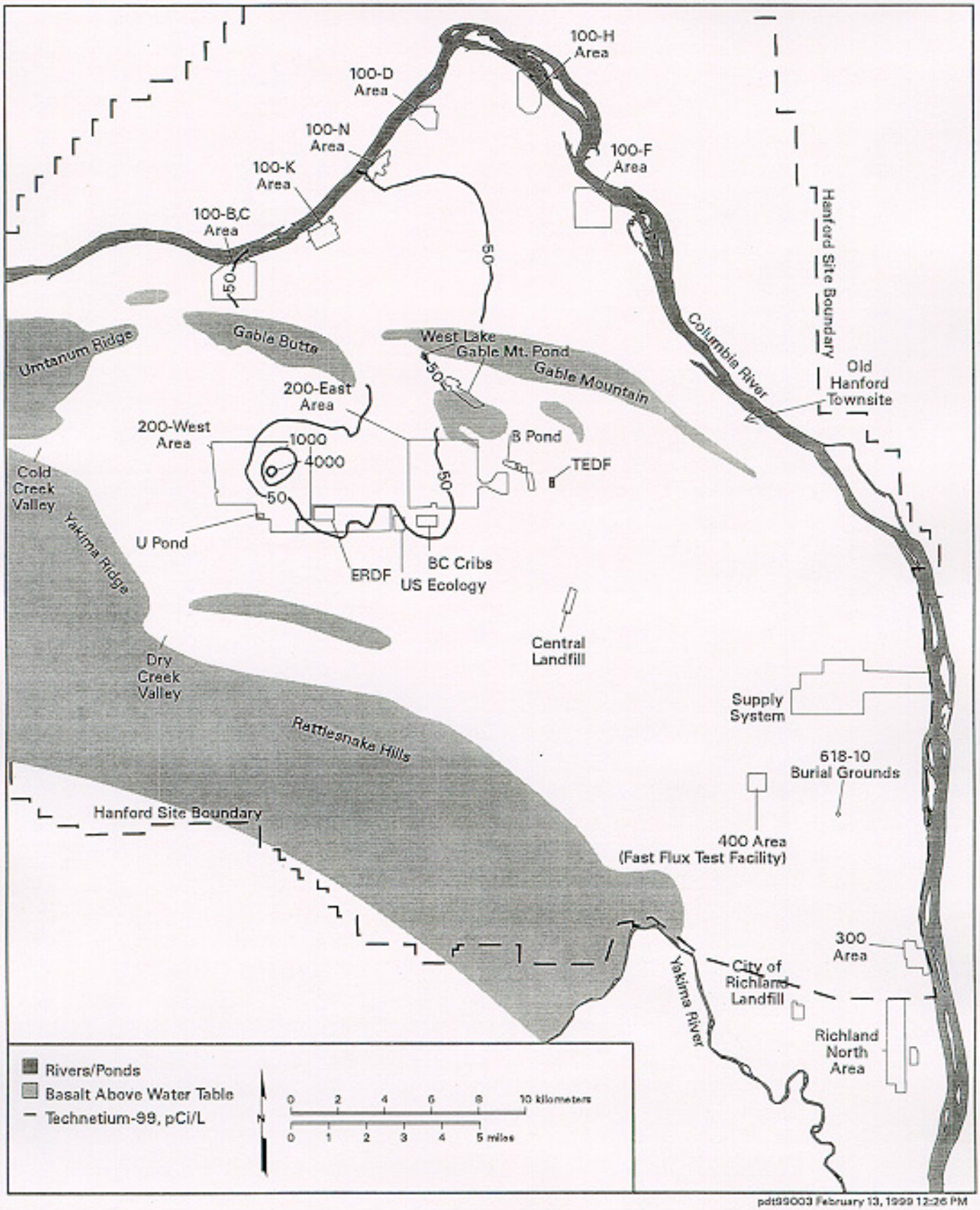


Figure 5-5. Predicted Uranium Plume from the 200 Areas for 2049.

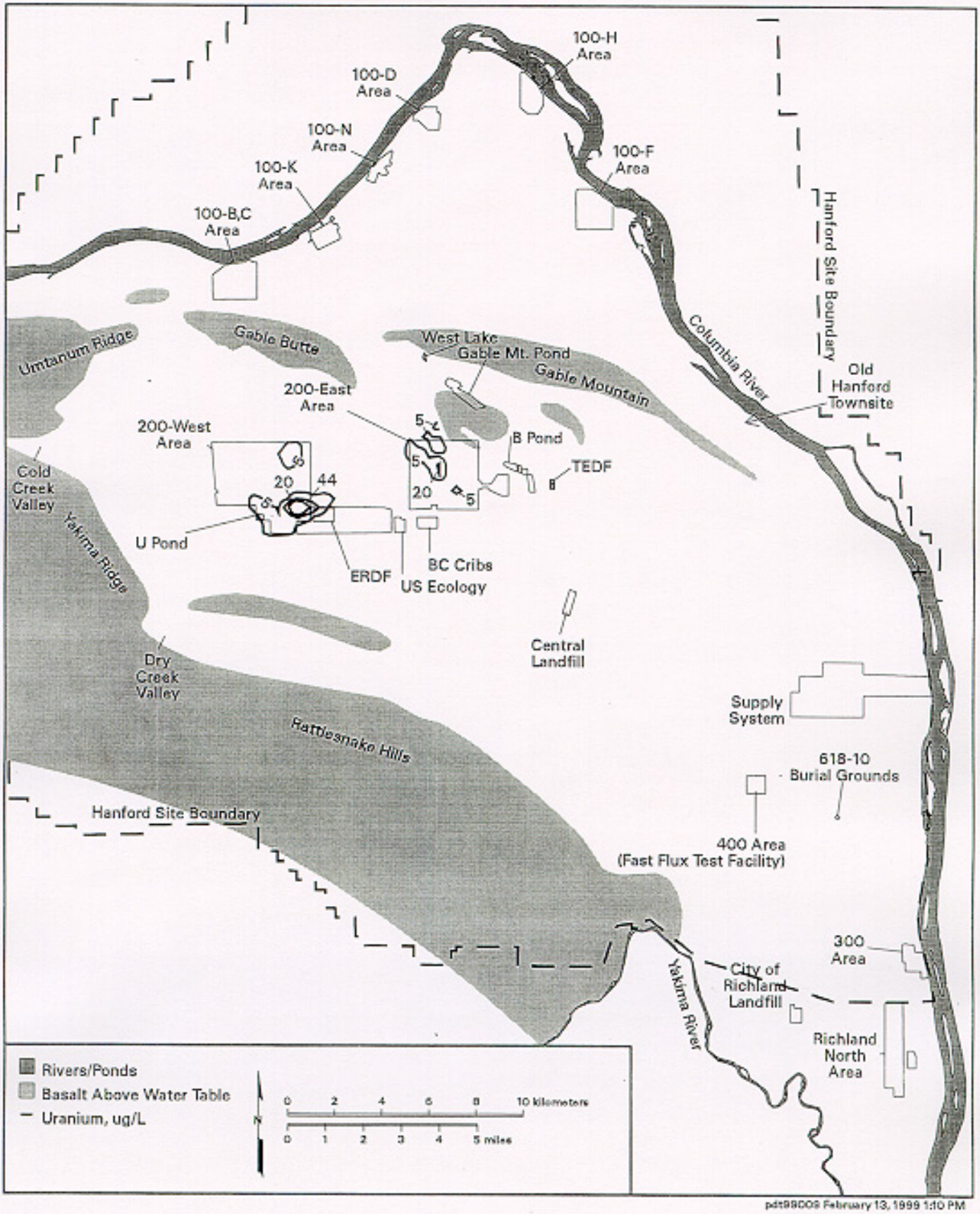


Figure 5-6. Predicted Strontium-90 Plume from the 200 Areas for 2049.

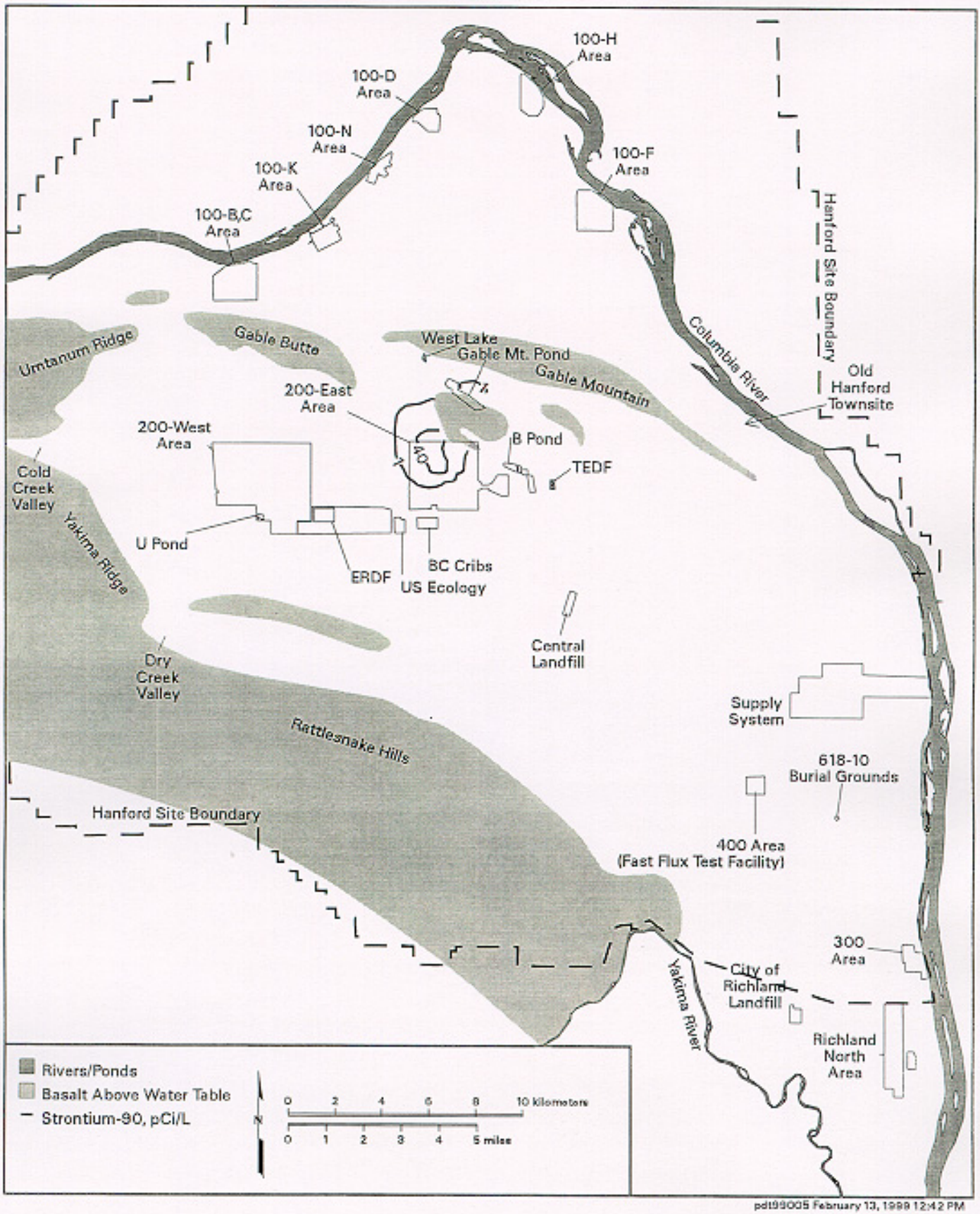


Figure 5-7. Predicted Carbon-14 Plume from the 200 Areas for 2049.

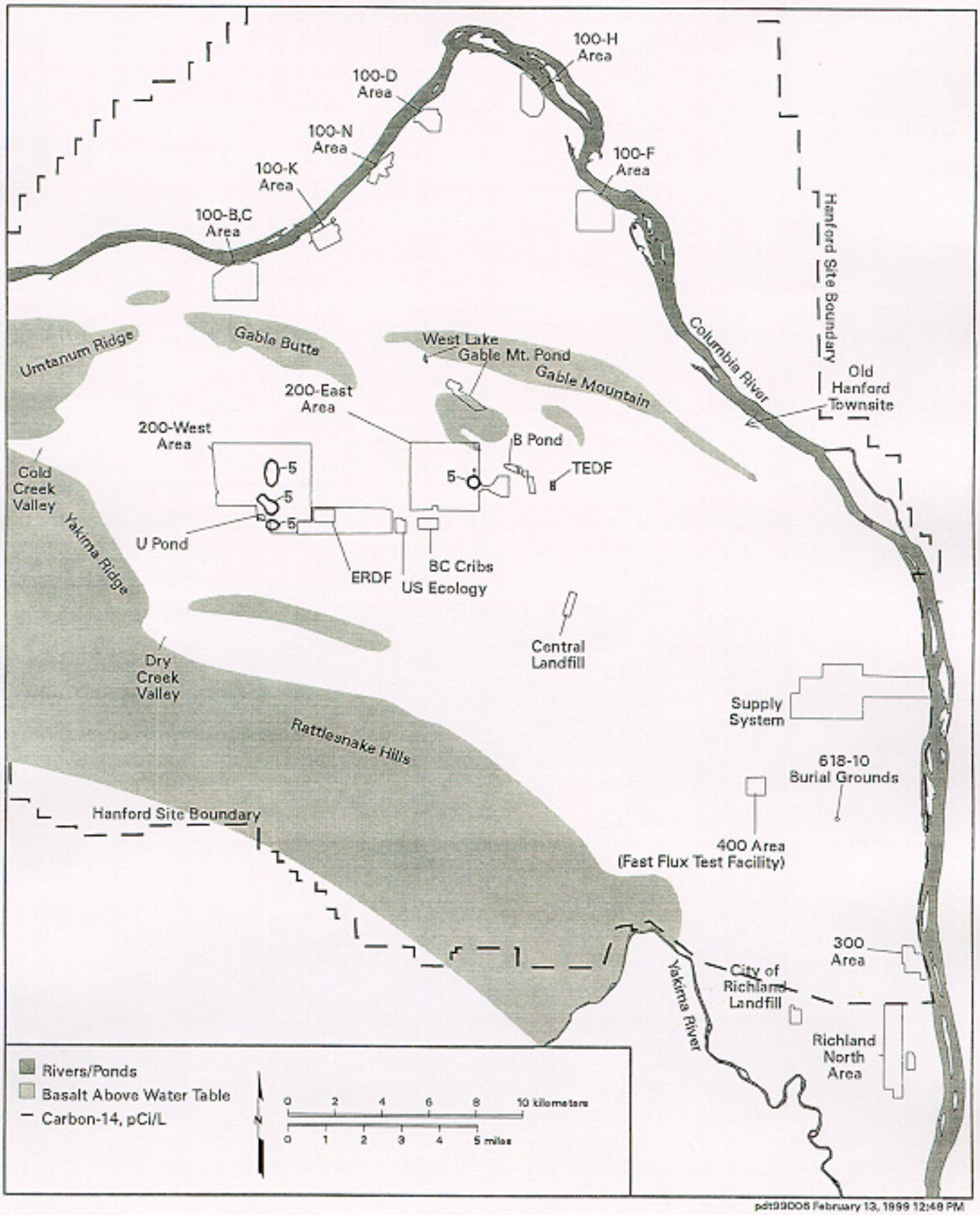


Figure 5-8. Predicted Chlorine-36 Plume from the 200 Areas for 2049.

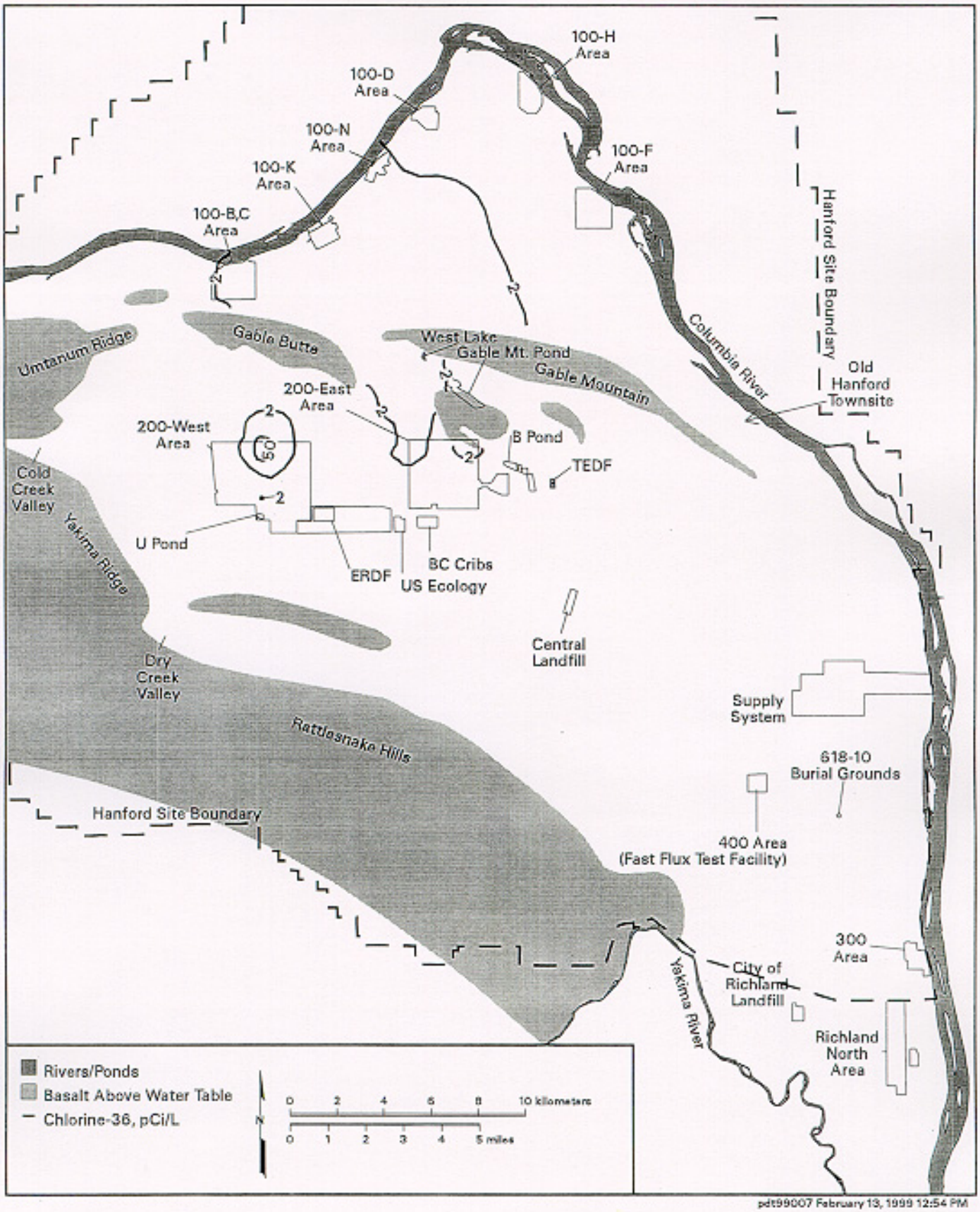


Figure 5-9. Predicted Selenium-79 Plume from the 200 Areas for 2049.

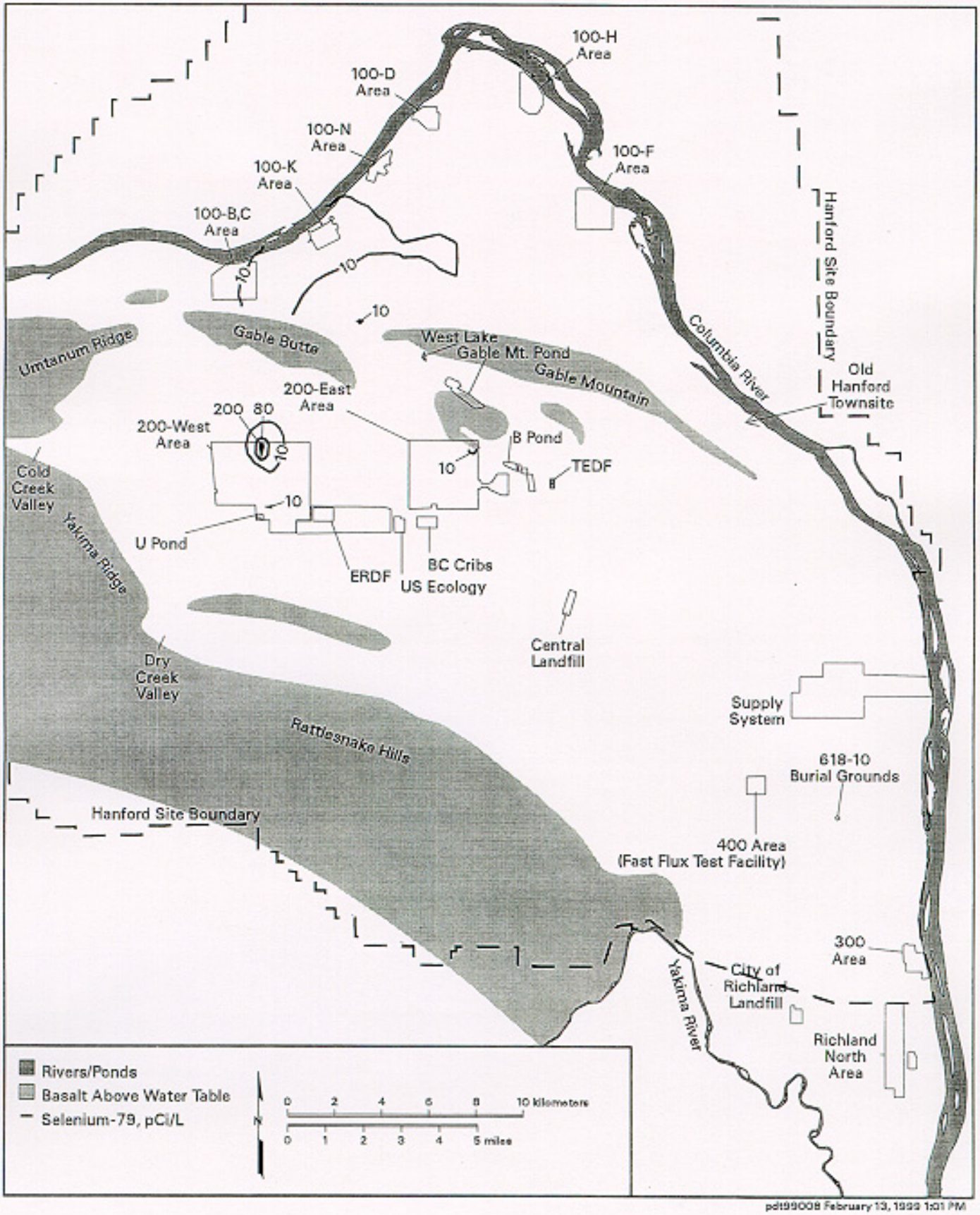


Table 5-5. Potential Impacts of Alternatives on the Vadose Zone and Groundwater.

Plan Map	Impacting Activity	Impacts to Vadose Zone and Groundwater (T = impact)[a]				
		Consumptive Use	Contamination (Spills)	Contamination (Agricultural Chemicals)	Mobilization of Contaminants	Changes to Hydrology
No-Action Alternative	Mining	T	T		T	T
	Livestock grazing					
	Cultivated agriculture	T	T	T	T	T
	Development	T	T		T	T
	Recreation					
Preferred Alternative	Mining	T	T		T	T
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T		T	T
	Recreation					
Alternative One	Mining	T	T		T	T
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T		T	T
	Recreation					
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development	T	T			
	Recreation					
Alternative Three	Mining	T	T		T	T
	Livestock grazing	T				
	Cultivated Agriculture	T	T	T	T	T
	Development	T	T		T	T
	Recreation					
Alternative Four	Mining	T	T		T	T
	Livestock Grazing					
	Cultivated Agriculture					
	Development	T	T		T	T
	Recreation					

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompanying text for significance of impacts.

Table 5-6. Potential Impacts of the Alternatives on Surface Water.

Plan Map	Impacting Activity	Impacts to Surface Water (T = impact)[a]			
		Consumptive Use	Degradation by Point Sources	Degradation by Non-Point Sources	Degradation by Sediment Loading
No-Action Alternative	Mining			T	T
	Grazing	T			T
	Agriculture	T		T	T
	Development	T	T	T	T
	Recreation				
Preferred Alternative	Mining	T		T	T
	Grazing				
	Agriculture				
	Development	T	T	T	
	Recreation				
Alternative One	Mining				
	Grazing				
	Agriculture				
	Development	T	T		
	Recreation				
Alternative Two	Mining				
	Grazing				
	Agriculture				
	Development		T	T	
	Recreation				
Alternative Three	Mining				
	Grazing	T			T
	Agriculture	T		T	T
	Development	T	T	T	
	Recreation				
Alternative Four	Mining				
	Grazing				
	Agriculture				
	Development	T	T	T	
	Recreation				

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompanying text for significance of impacts.

5.2.2.2 Preferred Alternative. Under the Preferred Alternative, mining operations could occur throughout much of the All Other Areas geographic area and on a portion of the ALE Reserve. Potential impacts to water resources as a result of mining operations would be similar to the potential impacts described for the No-Action Alternative.

The Preferred Alternative would allow industrial development in the eastern and southern

portions of the Hanford Site. As with the No-Action Alternative, industrial development under this alternative could alter groundwater flows through increased withdrawals. Industrial discharges to the soils column could mobilize contaminants in the vadose zone and accidental releases from industrial sites could contaminate the groundwater or the Columbia or Yakima Rivers. The potential for immediate contamination of the Columbia River is limited, however, as the 300 Area is the only Industrial land-use designation adjacent to the river under this alternative.

Recreational access to the Columbia River would be increased under the Preferred Alternative through adding new boat ramps and upgrading existing boat ramps. The Preferred Alternative would add three new access points to the Hanford Reach of the Columbia River, and would allow development of tribal fishing villages with supporting facilities. Increased access could increase boating activity on the river, which could increase shoreline erosion from wakes generated by motorized water craft. Increased boating activity could also generate additional pollutants (e.g., oil, gas, and engine exhaust).

5.2.2.3 Alternative One. Under Alternative One, mining would be limited to upland areas away from the Columbia River, and would have minimal affects on water quality.

Industrial development under Alternative One would be restricted to areas that have already been developed, the City of Richland urban growth area (UGA), and an area between the Energy Northwest (formerly known as the Washington Public Power Supply System, or WPPSS) site and the City of Richland UGA. Industrial development in these areas could have impacts such as those described for the Preferred Alternative, including changes in groundwater flows through drawdowns and groundwater contamination through accidental releases. However, these impacts are less likely to occur under Alternative One, as less land would be available for industrial development. Contamination of surface water from new point sources would be minimal under this alternative, as most areas designated for Industrial land use are located away from the Columbia and Yakima Rivers.

Alternative One would increase recreational access to the Columbia River by adding one new access point to the river at Vernita Bridge and maintaining an existing unimproved boat ramp at White Bluffs. The increased access could have impacts to water quality such as those described for the Preferred Alternative, although impacts under Alternative One may be less extensive because it would not provide access to as many areas.

5.2.2.4 Alternative Two. Under Alternative Two, mining, commercial grazing, and agriculture would not be allowed, and no impacts to water resources would occur as a result of these activities.

Areas proposed for industrial development under this alternative include the City of Richland UGA and areas that have already been developed. The potential for new impacts to water resources under this alternative is minimal; however, Alternative Two would allow experimental aqua-culture in the K Reactor area, and discharge of waste water from fish farming activities could add to the nutrient load in the Columbia River.

Alternative Two would not increase recreational access to the Columbia River and is unlikely to result in increased impacts to water quality from recreational uses.

5.2.2.5 Alternative Three. Alternative Three would allow mining activities in the All Other Areas geographic area and on the ALE Reserve, with impacts to groundwater similar to those described for the No-Action Alternative and the Preferred Alternative. Mining would not be permitted within 400 m (0.25 mi) of the Columbia River, and would be unlikely to affect river water quality.

Grazing under Alternative Three would be permitted in some areas on the Wahluke Slope, including wetland areas associated with irrigation water return flows. Grazing could reduce vegetation cover in wetlands and increase siltation in flows entering the Columbia River.

However, grazing under this alternative would not be allowed directly adjacent to the bank of the Columbia River.

Alternative Three would allow cultivated agriculture on much of the Wahluke Slope but would not allow agriculture within a corridor along the Columbia River. This buffer zone would minimize the potential for non-point source runoff of agricultural chemicals and eroded soils into the Columbia River. However, infiltration of agricultural chemicals could contaminate groundwater underlying cropland, and agriculture on the Wahluke Slope could also alter groundwater flow patterns. Increased groundwater recharge from irrigation would increase slumping along the White Bluffs, reducing their scientific, aesthetic, and cultural value. Increased slumping would add large quantities of sediment to the Columbia River, which could bury salmonid spawning areas and would alter flow patterns in the river and could mobilize contaminants, causing erosion of banks and islands.

Water resource impacts due to industrial development under Alternative Three would be similar to those described for the Preferred Alternative and could include changes in groundwater flow, mobilization of vadose zone contaminants, and possible groundwater and surface water contamination through accidental releases.

Recreational development under this alternative could include a golf course and destination resort on the Vernita Terrace. Runoff from parking lots and runoff or infiltration of agricultural chemicals from the golf course could impact water resources. However, development would not be permitted within 400 m (0.25 mi) of the Columbia River, which would minimize the potential affects of runoff on river water quality. The recreational development would involve consumption of large amounts of groundwater for culinary and sanitary uses at the resort and for irrigation of the golf course. Groundwater wells at the destination resort could result in changes in groundwater flows from aquifer drawdown, as well as possible groundwater mounding under sewage treatment facilities.

Alternative Three would increase recreational access to the Columbia River, with potential impacts from increased boating activity such as those described for the Preferred Alternative. However, Alternative Three would concentrate the increased recreational activity on the upper end of the Hanford Reach and at a location near the Yakima River. This could result in water quality impacts with higher intensity in these areas, but lower intensity in the lower portion of the Hanford Reach.

5.2.2.6 Alternative Four. As with Alternative One, Alternative Four would limit mining to upland areas away from the Columbia River and would result in minimal impacts to water quality from mining.

Water resource impacts due to industrial development under Alternative Four would be similar to those described for the Preferred Alternative and could include changes to groundwater flow from drawdown, mobilization of vadose zone contaminants, and possible contamination from accidental releases. However, these impacts may be less likely to occur, as less land would be available for industrial development.

Alternative Four would increase recreational access to the Columbia River by adding two new access points to the river at White Bluffs and Vernita Bridge, which would be associated with tribal fishing villages and support facilities. The increased access could have impacts to water quality such as those described for the Preferred Alternative, although impacts under Alternative Four may be less extensive because it would not provide access to as many areas.

5.2.2.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used to screen development proposals for Hanford Site lands. Some activities with the potential to impact water resources would not be permitted by DOE and others would be required to incorporate mitigation measures to reduce impacts. Mitigation measures that could reduce impacts to water resources include the following activities.

- Minimizing the use of groundwater so that water withdrawal would not alter groundwater flow and influence existing contamination plumes.

- Restricting irrigated agriculture on the Wahluke Slope, requiring hydrogeologic studies, or requiring efficient irrigation methods to minimize the potential for increased slumping of the White Bluffs.

- Designating “no wake” zones along the Columbia River in areas where the riverbank is subject to erosion.

- Employing agricultural practices that minimize the use of pesticides, fertilizers, and herbicides, thereby minimizing the potential for infiltration or runoff of these chemicals to groundwater or surface water.

- Requiring a demonstration of no adverse affect on vadose zone contaminants or contaminated groundwater plumes prior to allowing irrigation or industrial discharges to the soil column.

- Employing agricultural practices that minimize soil erosion.

- Using silt fences around development sites to contain soil erosion around those sites and minimize the potential for release of silt to surface water.

- Using soil stabilizing techniques around mining and development sites to contain wind erosion.

- Implementing water conservation measures wherever possible to minimize water use.

- Implementing spill control and cleanup measures to minimize the risk of contaminating water resources from accidental releases.

- Managing commercial grazing activities to minimize livestock access to wetlands and riverbanks (e.g., development of off-stream water sources).

- Requiring a demonstration of no adverse impact on groundwater due to increased infiltration and transportation of vadose zone contamination resulting from development.

5.2.3 Impacts to Biological Resources

Sensitive biological resources are present on the Hanford Site in association with the Columbia River, basalt outcrops with their talus slopes such as Gable Butte and Gable Mountain, sand dunes, low elevation deep soils, and other unique features. Biological resources considered for each alternative in this analysis include terrestrial vegetation and habitat, especially habitats identified through consideration of plant communities of concern; wildlife and wildlife habitat; aquatic species and habitat; wetlands; and biodiversity. The potential impacts of activities allowed under the alternatives on these biological resources are identified in Table 5-7.

Table 5-7. Potential Impacts of the Alternatives on Sensitive Biological Resources.

Alternative	Impacting Activity	Impacts to Biological Resources (T = impact)				
		Terrestrial Vegetation and Habitat	Wildlife and Wildlife Habitat	Aquatic Species and Habitat[a]	Wetlands	Biodiversity
No-Action	Mining	**T**	**T**	**T**	**T**	
	Livestock grazing	**T**	**T**	**T**	**T**	**T**
	Cultivated agriculture	**T**	**T**	**T**	**T**	**T**
	Development	**T**	**T**	**T**		**T**
	Recreation					
Preferred Alternative	Mining	**T**	**T**	**T**	**T**	
	Livestock grazing					
	Cultivated agriculture					
	Development	**T**	**T**			**T**
	Recreation			**T**		
Alternative One	Mining	**T**	**T**			
	Livestock grazing					
	Cultivated agriculture					
	Development	**T**	**T**			
	Recreation			**T**		
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development	**T**	**T**			
	Recreation					
Alternative Three	Mining	**T**	**T**			
	Livestock grazing	**T**	**T**	**T**	**T**	**T**
	Cultivated agriculture	**T**	**T**	**T**	**T**	**T**
	Development	**T**	**T**			**T**
	Recreation			**T**		
Alternative Four	Mining	**T**	**T**			
	Livestock grazing					
	Cultivated agriculture					
	Development	**T**	**T**			**T**
	Recreation			**T**		

[a] Aquatic species and habitats includes creeks, springs, riparian, and riverine (deep water) habitat. Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

Biological resources at the Hanford Site are also classified by level of concern under BRMaP (DOE-RL 1996c). This analysis is focused on resources classified as BRMaP Levels II, III, and IV, defined as follows:

- Level II resources include Washington State Monitor 1 and 2 species and early successional habitats.

- Level III resources include Washington State candidate, sensitive, threatened, and endangered species, Federal candidate species, wetlands and deep-water habitats, and late-successional habitats.

- Level IV resources include Federal threatened and endangered species and those species proposed for listing, and rare habitats such as the White Bluffs, active and stabilized sand dunes, and basalt outcrops.

Table 5-8 presents the potential impacts on biological resources that have been defined in BRMaP as Levels II, III, and IV from activities allowed under the alternatives. The amount of acreage of each BRMaP level under each land-use designation is tabulated from GIS spatial data in Table 5-9.

5.2.3.1 No-Action Alternative. The No-Action Alternative would allow continued development of the All Other Areas geographic area on a project-by-project basis. Without a land-use plan in place, it is less likely that facility siting would be coordinated to share utility corridors and conserve space. Biological resources would be damaged in localized areas where future development occurred. Construction of new facilities would require surface clearing and grading, which would eliminate vegetation and wildlife habitat present on the construction site and allow weed species to become established. New utility corridors could fragment habitats. Scattered development under the No-Action Alternative could also increase the risk of wildfire, which could result in large-scale losses of habitat. Future industrial development under the No-Action Alternative could affect biological resources associated with BRMaP Levels II, III, and IV, as shown in Table 5-9.

The No-Action Alternative would not preclude development of quarries on basalt outcrops such as the Umtanum Ridge, Gable Mountain, and Gable Butte, which could damage sensitive habitats in these locations. This alternative would also allow sand and gravel quarrying in most of the All Other Areas geographic area, and could affect BRMaP Levels II, III, and IV resources. Because basalt and sand and gravel quarries are typically limited in size, it is unlikely that habitat losses would be large enough to affect biodiversity. Conversely, mining of topsoil for covering and reclaiming remediation sites could disturb large areas and could affect biodiversity. Under the No-Action Alternative, the McGee Ranch could be developed as a quarry site for remediation. Large-scale soil mining at McGee Ranch could affect the connection between the large tracts of shrub-steppe habitat on the Hanford Site and those on the Yakima Training Center to the west. Mining at McGee Ranch could eliminate the wildlife movement corridor between these areas and increase habitat fragmentation. Isolating these two habitat remnants could reduce the genetic diversity of plant and animal species associated with shrub-steppe habitat and reduce regional biodiversity in the long term.

Although the No-Action Alternative does not designate lands for cultivated agriculture, this alternative would not preclude future agricultural development of Hanford Site lands. Assuming that cultivated agriculture would be established near the Columbia River to facilitate irrigation, the conversion to cropland could displace rare plants, riparian plant communities, and other BRMaP Level III and IV resources associated with the free flowing Hanford Reach. Cultivated agriculture adjacent to the Columbia River would increase sediment loading to the river, potentially affecting salmonid spawning areas. Agricultural chemicals in runoff from croplands could damage sensitive wetland and aquatic habitats.

Table 5-8. Potential Impacts to Biological Resources as Defined by BRMaP.

Alternative	Activity	Impact to BRMaP Resource Level of Concern (T = impact)[a]		
		II	III	IV
No-Action	Mining	**T**	**T**	**T**
	Livestock grazing	**T**	**T**	**T**
	Cultivated agriculture	**T**	**T**	**T**
	Development	**T**	**T**	**T**
	Recreation			
Preferred Alternative	Mining	**T**	**T**	**T**
	Livestock grazing			
	Cultivated agriculture			
	Development	**T**	**T**	
	Recreation		**T**	**T**
Alternative One	Mining			**T**
	Livestock grazing			
	Cultivated agriculture			
	Development	**T**	**T**	
	Recreation			
Alternative Two	Mining			
	Livestock grazing			
	Cultivated agriculture			
	Development	**T**	**T**	
	Recreation			
Alternative Three	Mining	**T**	**T**	**T**
	Livestock grazing	**T**	**T**	**T**
	Cultivated agriculture	**T**	**T**	**T**
	Development	**T**	**T**	
	Recreation	**T**	**T**	**T**
Alternative Four	Mining	**T**	**T**	**T**
	Livestock grazing			
	Cultivated agriculture			
	Development	**T**	**T**	
	Recreation		**T**	**T**

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

Table 5-9. Distribution of BRMaP Level II, III, and IV Resources Under the Nine Land-Use Designations for the Alternatives. (2 pages)

Land-Use Designation	No-Action Alternative	Preferred Alternative	Alternative One	Alternative Two	Alternative Three	Alternative Four
BRMaP II	**Hectares (35,909 total)**					
Preservation	1,113	3,297	24,414	34,427	381	13,664
Conservation (Mining)	0	15,940	10,806	0	14,309	13,462
Conservation (Mining & Grazing)	15,807	0	0	0	93	0
Industrial	18,840	11,590	538	744	12,495	4,610
Industrial-Exclusive	146	146	134	134	146	146
Research and Development	0	4,885	11	599	7,885	4,022
Low-Intensity Recreation	3	6	3	3	105	3
High-Intensity Recreation	0	45	2	0	355	1
Agriculture	0	0	0	0	139	0
BRMaP III	**Hectares (66,744 total)**					
Preservation	26,857	44,096	61,306	61,539	3,548	56,842
Conservation (Mining)	0	16,833	209	0	37,096	4,166
Conservation (Mining & Grazing)	33,396	0	0	0	3,578	0
Industrial	1,108	385	75	260	706	310
Industrial-Exclusive	3,115	3,115	2,672	2,672	3,115	3,115
Research and Development	0	<1	194	4	13	<1
Low-Intensity Recreation	2,268	2,295	2,287	0	2,379	6
High-Intensity Recreation	0	19	<1	1	56	37
Agriculture	0	0	0	0	16,251	0
BRMaP IV	**Hectares (9,260 total)**					
Preservation	7,180	7,895	7,905	9,260[a]	1,178	9,260[a]
Conservation (Mining)	0	0	0	0	6,450	0
Conservation (Mining & Grazing)	721	0	0	0	65	0
Industrial	4	0	0	0	0	0
Industrial-Exclusive	0	0	0	0	0	0
Research and Development	0	0	0	0	0	0
Low-Intensity Recreation	1,355[a]	1,355[a]	1,355[a]	0	1,355[a]	0
High-Intensity Recreation	0	<1	0	0	<1	0
Agriculture	0	0	0	0	211	0

[a] Area includes Columbia River surface area.

Although the No-Action Alternative would not preclude cultivated agriculture, mining, or industrial development adjacent to the Columbia River, such developments would have to be reviewed by the National Park Service for compatibility with the proposed Wild and Scenic River designation for the Columbia River. This review may prevent the siting of impacting activities near the river, and effectively provide protection of biological resources in the Columbia River Corridor under any of the alternatives being considered.

Grazing of livestock on the Wahluke Slope under the No-Action Alternative could alter terrestrial vegetation communities by eliminating or reducing the cover of some species, encouraging the growth of grazing-tolerant species, and providing opportunities for weed species to become established. These changes could adversely affect associated wildlife species. Cessation of grazing could increase the fire danger by providing flash and step fuel biomass such as cheatgrass that carries a range fire between brushy areas. Wetland and riparian plant communities could be damaged where livestock congregate near water sources.

Although the No-Action Alternative would continue to allow recreational use of the Hanford Reach, no new boat ramps or other recreational development would be planned. The No-Action Alternative is not likely to result in increased recreational impacts to biological resources associated with the Columbia River.

5.2.3.2 Preferred Alternative. Industrial development under the Preferred Alternative could disturb previously undisturbed land areas, including areas containing BRMaP Level II and III resources in the southern portion of the All Other Areas geographic area. Construction of new facilities would require surface clearing and grading, which would eliminate vegetation and wildlife habitat present on the construction site and provide opportunities for weed species to become established. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation and encourage dune activation. The Preferred Alternative, through implementation of the CLUP's policies and implementing procedures (see Chapter 6), would mitigate the disturbance, encouraging the clustering of future developments and sharing of utility corridors, conserving space and minimizing disturbance. Industrial development under the Preferred Alternative would be less likely to fragment habitats or affect biodiversity than under the No-Action Alternative.

The Preferred Alternative would designate much of the All Other Areas geographic area for Conservation (Mining). In addition, a small portion of the ALE Reserve, which has been identified as an alternative basalt source, would be designated for Conservation (Mining). Biological resources located at quarry sites would be damaged or destroyed. The area in the ALE Reserve where mining would be permitted contains BRMaP Level I and II resources.

The Preferred Alternative would increase recreational access to the Columbia River by allowing additional boat launch facilities to be constructed. Increased boating activity on the river could adversely affect salmonid spawning areas, aquatic plant communities and other BRMaP Level III and IV resources. Development of biking and hiking trails and other recreational facilities could also damage plant communities of concern, and disturb bald eagle roosts and great blue heron rookeries along the Hanford Reach. With increased access, there would also be an increase in the probability of a wildfire occurring.

The Preferred Alternative would assign the Preservation land-use designation to approximately 53 percent (78,127 ha [193,056 ac]) of the Hanford Site, including the Wahluke Slope, most of the ALE Reserve, the basalt outcrops, the McGee Ranch area, the shoreline of the Columbia River, river islands, and the active sand dunes. The Preservation land-use designation would protect approximately 66 percent (44,096 ha [108,964 ac]) of BRMaP Level III and 85 percent (7,895 ha [19,509]) of BRMaP Level IV resources on the Hanford Site.

5.2.3.3 Alternative One. Industrial development under Alternative One would be allowed in areas where development has already impacted sensitive habitats and in an area south of the Energy Northwest (formerly known as WPPSS) site where cheatgrass dominates the vegetation cover. These areas consist mainly of BRMaP Level I and II resources. Industrial development under Alternative One would result in destruction of habitat, but the impacts would be less extensive and to lower quality habitat than under the Preferred Alternative or the No-Action Alternative because of the limited areas available for development.

Alternative One would minimize the area designated for Industrial-Exclusive use to preserve the maximum amount of high-quality, late-successional shrub-steppe habitat located west of the 200 West Area. An additional 443 ha (1,108 ac) of BRMaP Level III resources would be protected under the Preservation land-use designation in this area, as compared to the Preferred Alternative and the No-Action Alternative.

Under Alternative One, the Conservation (Mining) land-use designation would be assigned to areas around LIGO and FFTF, and in other scattered locations in the 100 and 600 Areas. Biological resources at many of these locations have been previously impacted and are classified as BRMaP Level I and II. Other areas contain BRMaP Level III and IV resources that could be damaged by basalt and sand and gravel quarrying. Impacts to these resources are less likely than under the Preferred Alternative or No-Action Alternative, however, because mining under Alternative One would be limited to supporting remediation activities.

Alternative One would increase recreational access to the Columbia River by allowing an additional boat launch facility to be constructed. Increased boating activity on the river could adversely affect biological resources associated with the Hanford Reach. Impacts would be less extensive than under the Preferred Alternative because access would not be provided to as many locations.

Alternative One would assign the Preservation land-use designation to approximately 84 percent (124,517 ha [307,688 ac]) of Hanford Site, including most of the ALE Reserve, the basalt outcrops, the McGee Ranch area, the Saddle Mountain NWR, the entire Columbia River Corridor, and the active and most stabilized sand dunes. The Preservation land-use designation would protect approximately 92 percent (61,306 ha [151,490 ac]) of BRMaP Level III and 85 percent (7,905 ha [19,534 ac]) of BRMaP Level IV resources.

5.2.3.4 Alternative Two. Under Alternative Two, lands designated for industrial development are mostly occupied by existing facilities, although some BRMaP Level II and Level III resources are included under the Industrial and Research and Development land-use designations. Industrial development under Alternative Two could result in destruction of habitat, but the impacts would be less extensive than under any of the other alternatives being considered because of the limited areas available for development. By limiting the amount of area to be developed, Alternative Two (by land-use designation rather than by CLUP policies and implementing procedures), advocates the clustering of future development.

Alternative Two, like Alternative One, would minimize the area designated for Industrial-Exclusive use in order to preserve the maximum amount of high-quality, late-successional shrub-steppe habitat located west of the 200 West Area. An additional 443 ha (1,108 ac) of BRMaP Level III resources would be protected under the Preservation land-use designation in this area, as compared to the Preferred Alternative and the No-Action Alternative.

Alternative Two would not increase recreational access to the Columbia River, and would be unlikely to result in increased impacts to biological resources associated with the river.

Alternative Two would assign the Preservation land-use designation to approximately 95 percent (140,767 ha [347,843 ac]) of Hanford Site, including the ALE Reserve, Wahluke Slope, Columbia River Corridor, and much of the All Other Areas geographic area. The Preservation

land-use designation would protect approximately 92 percent (61,539 ha [152,066 ac]) of the BRMaP Level III and 100 percent (9,260 ha [22,882 ac]) of the BRMaP Level IV resources.

5.2.3.5 Alternative Three. Under Alternative Three, the Industrial and Research and Development land-use designations would be larger than under any of the other alternatives, but would mainly consist of BRMaP Level I and II resources. Impacts to biological resources from industrial development under Alternative Three would be similar to those described for the Preferred Alternative.

Alternative Three would designate the ALE Reserve and much of the All Other Areas geographic area as Conservation (Mining). Basalt and sand and gravel quarries developed in these areas could impact rare plants and sensitive plant communities, depending on their relative locations, but CLUP policies and implementing procedures would mitigate against such impacts. Basalt and sand and gravel quarrying could affect BRMaP Level II, III, and IV resources. Because basalt and sand and gravel quarries are typically limited in size, it is unlikely that habitat losses would be large enough to affect biodiversity.

Under Alternative Three, lands in the Wahluke Slope could be converted to agriculture, which would involve conversion of native plant communities to cropland, pasture land, and orchards. Habitats of concern, including BRMaP Level II, III, and IV resources, would be damaged or destroyed. Conversion of native plant communities to cropland would reduce biodiversity by replacing complex plant communities with monocultures and allowing invasion of non-native species. Biodiversity also could be affected on portions of the Wahluke Slope designated for Conservation (Mining and Grazing), where livestock grazing could alter native plant communities. Converting the Wahluke Slope to irrigated agriculture could accelerate the collapse of the White Bluffs and destroy salmon spawning areas by siltation of the spawning gravels in the Columbia River.

Alternative Three would allow High-Intensity Recreational development of the Vernita Terrace, and Low-Intensity Recreational use of a large portion of the 100 Areas near the Columbia River. Development of a destination resort at Vernita Terrace would impact mostly BRMaP Level I resources, as this area consists of cheatgrass and abandoned fields. Construction of Low-Intensity Recreational facilities, such as the proposed recreational trail along the river, could result in habitat losses, including BRMaP Level II, III, and IV resources. However, such trails and other facilities would be sited according to the CLUP policies and implementing procedures to minimize impacts to BRMaP Level II, III, and IV resources. Increased recreational access to the Columbia River under this alternative would increase boating activity and could result in impacts to salmonid spawning areas, bald eagle roosts, great blue heron rookeries, and aquatic plant communities. Increased access could also result in the increased probability of wildfire. Recreational facilities would be located at least one-quarter mile from the river with Low-Intensity access points.

Alternative Three would assign the Preservation land-use designation to approximately 6 percent (9,002 ha [22,244 ac]) of Hanford Site lands, primarily along the Columbia River corridor. The Preservation land-use designation would protect approximately 5 percent (3,548 ha [8,767 ac]) of BRMaP Level III and 13 percent (1,178 ha [2,911 ac]) of BRMaP Level IV resources on the Hanford Site. As with the other alternatives being considered, Alternative Three would also protect sensitive biological resources through the Conservation (Mining) land-use designation with mining only by DOE's special-use permit, as described in Chapter 6 policies and implementing procedures. Under Alternative Three, the Conservation (Mining) land-use designation includes 56 percent (37,096 ha [91,666 ac]) of BRMaP Level III and 70 percent (6,450 ha [15,938 ac]) of BRMaP Level IV resources on the Hanford Site.

5.2.3.6 Alternative Four. Alternative Four would allow industrial development in the City of Richland UGA, in previously developed sites, such as Energy Northwest (formerly known as WPPSS), FFTF, 300 Area, and undisturbed areas north of the City of Richland UGA, which contain mainly BRMaP Level I and II resources. Construction of new industrial or R&D facilities

would require surface clearing and grading, which would eliminate vegetation and wildlife habitat present on the construction site and provide opportunities for weed species to become established. Industrial development in the southeast portion of the Hanford Site would destroy dune stabilizing vegetation. Industrial development under Alternative Four would be less likely to fragment habitats and affect biodiversity than the Preferred Alternative or Alternative Three, because the areas available for development would be smaller, of lesser quality, and closer to existing infrastructure.

Under Alternative Four, a portion of the All Other Areas geographic area and a small portion of the ALE Reserve would be managed under the Conservation (Mining) land-use designation. Lands within the ALE Reserve under this land-use designation are classified as BRMaP Levels I and II. The portion of the All Other Areas geographic area available for mining includes BRMaP Levels II and III resources. Basalt and sand and gravel quarries developed in these areas could impact rare plants and sensitive plant communities, depending on their location. Because basalt and sand and gravel quarries are typically limited in size and would be permitted by DOE, it is unlikely that habitat losses would be large enough to affect biodiversity.

Alternative Four would increase recreational access to the Columbia River by adding two new access points to the river at White Bluffs and Vernita Bridge, which would be associated with tribal fishing villages and support facilities. The increased access could have impacts to biological resources such as those described for the Preferred Alternative, although impacts under Alternative Four may be less extensive because it would not provide access to as many areas.

Alternative Four would assign the Preservation land-use designation to approximately 76 percent (112,321 ha [277,551 ac]) of Hanford Site, including the Wahluke Slope, the Columbia River Corridor, most of the ALE Reserve, the basalt outcrops and active sand dunes, and other portions of the All Other Areas geographic area. The Preservation land-use designation would protect approximately 85 percent (56,842 ha [140,460 ac]) of BRMaP Level III and 100 percent (9,260 ha [22,882 ac]) of BRMaP Level IV resources on the Hanford Site.

5.2.3.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used to screen development proposals for Hanford Site lands. All proposals, including the No-Action Alternative, potentially affecting sensitive biological resources would be required to comply with applicable statutes, such as the *Endangered Species Act of 1973*, the *Bald and Golden Eagle Protection Act of 1972*, the *Migratory Bird Treaty Act of 1918*, and other statutes, Executive Orders, and policies discussed in Chapter 7. Some activities with the potential to impact habitats of concern would not be permitted by DOE and others would be modified or required by CLUP policies and implementing procedures to incorporate mitigation measures to reduce impacts. Mitigation measures that could reduce impacts to biological resources include the following:

- Minimize disturbance of wetlands and replace disturbed wetlands through purchase, construction, or restoration of wetlands.

- Mitigation for remedial actions should occur near the site of the disturbance as a first priority or, if that is not feasible, be performed as compensatory mitigation on areas designated for Conservation or Preservation.

- Revegetate disturbed areas using native vegetation.

- Schedule activities to avoid critical nesting, roosting, leking, breeding, and fawning times.

5.2.4 Cultural Resources

Impacts to cultural resources may include damage or destruction of archaeological and

historic sites and artifacts, as well as disruption of religious and traditional uses of the Hanford Site by American Indians. Impacts of the alternatives on Hanford Site cultural resources are summarized in Table 5-10.

5.2.4.1 No-Action Alternative. The No-Action Alternative would allow quarrying from basalt outcrops that have traditional, cultural, and religious importance to American Indians. The No-Action Alternative also would allow sand and gravel mining and industrial development in most of the All Other Areas geographic area, which would alter the viewsheds associated with religious sites. These activities and cultivated agriculture (which could be allowed under the No-Action Alternative) could also displace natural resources traditionally gathered by American Indians and disturb archaeological and historic sites. Ground-disturbing activities adjacent to the Columbia River could also increase sediment loading to the Columbia River, which could damage salmonid spawning areas and potentially affect American Indian fishing as a cultural activity. Although the No-Action Alternative would not increase recreational access to the Columbia River, archaeological sites would remain at risk to unauthorized artifact collection and riverbank erosion from boat wakes.

5.2.4.2 Preferred Alternative. Although the Preferred Alternative would preclude quarrying of basalt outcrops such as Gable Mountain and Gable Butte, mining of other areas could damage or destroy archaeological and historic sites and displace natural resources traditionally gathered by American Indians. Mining and industrial development could also affect viewsheds associated with American Indian religious sites.

The Preferred Alternative would allow industrial development in the Central Plateau and in the southeastern portion of the Hanford Site. Although these areas already include developed sites (e.g., 200 Areas, Energy Northwest [formerly known as WPPSS], FFTF, and 300 Area), large land areas remain that have not been disturbed. Development of these areas could result in damage to or destruction of archaeological and historic sites and displacement of natural resources traditionally gathered by American Indians.

The Preferred Alternative would increase recreational access to the Columbia River by allowing additional boat launch facilities to be constructed. The Low-Intensity Recreation land-use designation would also allow increased recreational use of the Vernita Terrace. Increased recreational uses along the Columbia River could result in damage to natural resources traditionally gathered by American Indians and impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and erosion of riverbanks from boat wakes.

Table 5-10. Potential Impacts of Land-use Alternatives on Cultural Resources.

Alternative	Impacting Activity	Impacts to Key Cultural Resource Areas (T = impact)[a]				
		Religious Sites	Viewsheds	Natural Resource Gathering Areas	Archaeological and Burial Sites	Historic Sites
No-Action	Mining	T	T	T	T	T
	Livestock grazing	T		T	T	
	Cultivated agriculture		T	T	T	T
	Development		T	T	T	T
	Recreation				T	
Preferred Alternative	Mining		T	T	T	T
	Livestock grazing					
	Cultivated agriculture					
	Development		T	T	T	T
	Recreation			T	T	T
Alternative One	Mining		T	T	T	T
	Livestock grazing					
	Cultivated agriculture					
	Development				T	T
	Recreation			T	T	T
Alternative Two	Mining					
	Livestock grazing					
	Cultivated agriculture					
	Development				T	T
	Recreation					
Alternative Three	Mining	T	T	T	T	T
	Livestock grazing	T		T	T	
	Cultivated agriculture		T	T	T	T
	Development		T	T	T	T
	Recreation			T	T	T
Alternative Four	Mining		T	T	T	T
	Livestock grazing					
	Cultivated agriculture					
	Development			T	T	T
	Recreation				T	T

[a] Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

5.2.4.3 Alternative One. Under Alternative One, mining to support remediation would be allowed in scattered locations in the All Other Areas geographic area. Although some archaeological sites in these areas were previously disturbed by pre-Hanford farming or by construction of Hanford Site facilities, cultural artifacts may remain that could be impacted by mining. Mining in these areas could affect native plant communities and animals of importance to American Indians. However, this impact is less likely to occur under Alternative One than under the Preferred Alternative, because less land would be available for mining and much of it has been previously disturbed.

Alternative One would limit the Industrial and Research and Development land-use designations to the Central Plateau, Energy Northwest (formerly known as WPPSS) site, 300 Area, and the City of Richland UGA, where some archaeological and historic sites have already been identified and mitigated. The Industrial land-use designation also includes an area located south of the Energy Northwest (formerly known as WPPSS) site where cheatgrass dominates the vegetation cover. Future industrial development in this area could disturb archaeological or historic sites. Archaeological sites could also be disturbed by future development under the Industrial-Exclusive land-use designation on the Central Plateau, although Alternative One would protect more of these resources in the Central Plateau than would the Preferred Alternative.

Alternative One would increase recreational access to the Columbia River by allowing an additional boat launch facility to be constructed. Increased recreational uses along the Columbia River could result in damage to natural resources traditionally gathered by American Indians and impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and riverbank erosion from boat wakes. These impacts would be less extensive under Alternative One than under the Preferred Alternative, which would allow higher levels of recreational use.

5.2.4.4 Alternative Two. Industrial development under Alternative Two would be limited to the Central Plateau, Energy Northwest (formerly known as WPPSS) site, 300 Area, and areas adjacent to the City of Richland. Archaeological and historic resources in most of these areas have already been identified and mitigated. New development in areas of the Central Plateau could disturb additional sites, although Alternative Two would protect more of these resources in the Central Plateau than would the Preferred Alternative. Alternative Two would designate most of the Hanford Site for Preservation, which would minimize future impacts to cultural resources.

5.2.4.5 Alternative Three. Under Alternative Three, areas with known cultural resources, including the ALE Reserve, could be affected by mining if permitted by CLUP policies and implementing procedures. However, this alternative would not allow mining or other development within 400 m (0.25 mi) of the Columbia River Corridor, where cultural resources are concentrated. Mining, cultivated agriculture, and industrial development under this alternative could alter viewsheds associated with religious sites used by American Indians.

Alternative Three would allow industrial and R&D in the Central Plateau and in the eastern and southern portions of the Hanford Site. Although these areas already include developed sites, such as the 200 Areas, Energy Northwest site, FFTF, and 300 Area, there remain large land areas that have not been disturbed. Development of these areas could result in damage to or destruction of archaeological and historic sites and displacement of natural resources traditionally gathered by American Indians.

Alternative Three would allow conversion of much of the Wahluke Slope to croplands under the Agricultural land-use designation. Conversion to croplands would involve removal of native vegetation important to American Indians. Tillage of croplands would damage or destroy archaeological and historic sites. Irrigated agriculture would increase slumping of the White Bluffs, which have cultural significance to American Indians. Increased slumping could also

impact American Indian cultural fishing and other fishing and could alter the river channel, causing losses of cultural resources to riverbank and island erosion.

Agricultural development and commercial grazing on the Wahluke Slope would also alter native plant communities and displace animals of importance to American Indians. Archaeological and burial sites could be damaged where livestock gather, such as at water sources.

Alternative Three would increase recreational access to the Columbia River by designating a large portion of the 100 Areas for Low-Intensity Recreation, as well as designating the Vernita Terrace and the B Reactor area for High-Intensity Recreation. Development of recreational facilities could damage archaeological and historic sites in these areas. Increased recreational uses along the Columbia River could also result in damage to natural resources traditionally gathered by American Indians and impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and riverbank erosion from boat wakes. An area near Horn Rapids on the Yakima River designated for High-Intensity Recreation could have similar impacts to cultural resources and the culturally important viewshed.

5.2.4.6 Alternative Four. Alternative Four would allow mining that followed the CLUP's policies and implementing procedures in support of remediation in the southern portion of the All Other Areas geographic area. Mining in this area could alter viewsheds associated with religious sites used by American Indians.

Alternative Four would designate southeastern portions of the Hanford Site for Industrial and Research and Development uses. Although these areas already include developed sites (e.g., Energy Northwest [formerly known as WPPSS], FFTF, and the 300 Area), other areas under these designations have not previously been disturbed. Development of these areas could result in damage to or destruction of archaeological and historic sites and displacement of natural resources traditionally gathered by American Indians. These impacts would be less extensive under this alternative than under the Preferred Alternative or Alternative Three because less land would be available for development.

Alternative Four would increase recreational access to the Columbia River by allowing additional boat launch facilities to be constructed. Increased recreational uses along the Columbia River could result in impacts to archaeological and historic sites from unauthorized artifact collection, vandalism, and riverbank erosion from boat wakes. These impacts may be less extensive under Alternative Four than under the Preferred Alternative because this alternative would not provide access to as many areas.

5.2.4.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used by DOE to screen development proposals for Hanford Site lands. Impacts of specific proposed projects would be evaluated through the NEPA process including potential impacts on tribal member's treaty rights and known archaeological and historic sites. Some projects may not be permitted and others may be required to incorporate mitigation measures to reduce the impacts. Mitigation measures that could reduce impacts to cultural resources include the following:

- Restrict irrigated agriculture on the Wahluke Slope, requiring hydrogeologic studies, or requiring efficient irrigation methods to minimize the potential for increased slumping of the White Bluffs.

- Continue to conduct cultural resource surveys of proposed project locations in accordance with Neitzel et al. 1997.

- Continue to schedule activities to avoid conflicts with American Indian traditional and religious uses.

- Continue to conduct consultations with the RL Cultural Resources Program Manager, the State Historic Preservation Office, affected Tribal governments, and Wanapum Band representatives to identify additional mitigation measures or project alternatives.

5.2.5 Aesthetic Resources

In this document, key aesthetic resources include viewing locations, viewsheds, visibility (ambient air quality), odors, and ambient noise levels. Adoption of any particular alternative would not directly impact aesthetic resources; however, activities allowed under the various alternatives could have different affects on these resources.

Impacts of the alternatives on aesthetic resources are described in the following sections and are summarized in Table 5-11. The primary impacts to aesthetic resources would occur as a result of altering viewsheds through mining or development, visibility or odor impacts from release of atmospheric pollutants from industrial activities, visibility impacts from releases of fugitive dust from construction sites and seasonally from agricultural activities, and new noise impacts as a result of development, mining, or recreation in areas that are typically quiet.

Under all alternatives, new development projects would be subject to a New Source Review in accordance with the requirements of *Washington Administrative Code* (WAC) 173-400. The New Source Review would identify probable air emissions and air emission control technology would be required, if necessary, to comply with Washington State air-quality thresholds.

5.2.5.1 No-Action Alternative. Under the No-Action Alternative, a quarry operation could be developed on Gable Mountain or Gable Butte, affecting access to these viewing locations. Mining and industrial development activities under this alternative could alter the viewsheds associated with the basalt outcrops. These activities could be widely dispersed under the No-Action Alternative and would stand out against the relatively undisturbed surrounding terrain.

Potential impacts to visibility under this alternative would occur as a result of temporary releases of fugitive dust from construction sites, seasonal releases of fugitive dust from agricultural fields, releases of fugitive dust during mining or quarrying operations, and from releases of pollutants from developed sites.

Potential noise impacts under the No-Action Alternative would include blasting associated with quarry operations, noise generated seasonally by agricultural machinery, and industrial noise around new industrial sites. Depending on the location of the activities, these noise impacts could detract from the recreation experience of recreationists on the Wahluke Slope and along the Columbia River.

Commercial grazing by domestic animals could destroy wetland vegetation, create mud holes, create obnoxious odors, create noise, and be a source of weed and insect pests. Grazing could detract from the recreation experience of recreationists, including hikers, hunters, fishers, and wildlife watchers using areas designated for Low-Intensity Recreation, Conservation, and Preservation; and could disrupt wildlife.

Table 5-11. Potential Impacts of Land-Use Alternatives on Aesthetic Resources.

Plan Map	Impacting Activity	Impacts to Aesthetic Resources (T = impact)		
		Viewsheds	Ambient Visibility	Ambient Noise Levels
No-Action Alternative	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture	T	T	T
	Development	T	T	T
	Recreation			T
Preferred Alternative	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	T
	Recreation			T
Alternative One	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development		T	T
	Recreation			T
Alternative Two	Mining			
	Livestock grazing			
	Cultivated agriculture			
	Development		T	
	Recreation			
Alternative Three	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture	T	T	T
	Development	T	T	T
	Recreation	T		T
Alternative Four	Mining	T	T	T
	Livestock grazing			
	Cultivated agriculture			
	Development	T	T	T
	Recreation			T

Checkmarks do not represent adverse impacts of comparable significance; refer to accompany text for significance of impacts.

5.2.5.2 Preferred Alternative. Under the Preferred Alternative, viewing locations associated with basalt outcrops and the ALE Reserve would not be disturbed. Viewing locations associated with the Columbia River could be disrupted through development of a mining operation outside a quarter mile from the river. Mining operations would also be permitted within the viewsheds of basalt outcrops. An area designated for Industrial use is within the viewshed of Gable Mountain. Impacts to visibility could include releases of fugitive dust from construction sites and pollutants from new industrial sites.

Noise impacts under the Preferred Alternative could include blasting during quarry operation, increased noise in the vicinity of new industrial sites, and noise from increased motorized watercraft use on the Columbia River. The increased noise levels from these activities could detract from the recreation experience of recreationists, including hikers, hunters, fishers,

and wildlife watchers using areas designated for Low-Intensity Recreation, Conservation, and Preservation; and could disrupt wildlife.

5.2.5.3 Alternative One. Under Alternative One, viewing locations associated with basalt outcrops, the Columbia River, and the ALE Reserve would be protected. Mining operations would be permitted within the viewshed of Gable Mountain, but with the exception of the 200 Areas, only limited industrial development would be permitted within the viewshed. Visibility impacts could include emissions of fugitive dust from mining operations and construction sites, along with potential emissions of pollutants from industrial activities.

Noise impacts under Alternative One could include blasting during quarry operation, increased noise in the vicinity of new industrial sites, and noise from increased motorized watercraft use on the Columbia River. Because areas designated for development are in close proximity to previously developed areas, new noise sources are not likely to affect previously quiet areas. Noise from blasting and from recreational activities along the Columbia River could affect some areas that are presently quiet, detracting from the recreation experience of recreationists and potentially disrupting wildlife.

5.2.5.4 Alternative Two. Alternative Two would allow minimal new development on the Hanford Site, protecting existing viewing locations and viewsheds. New industrial development could occur in the City of Richland UGA, but would have minimal visibility and noise impacts to recreationists.

5.2.5.5 Alternative Three. Alternative Three would allow quarrying operations on basalt outcrops and mining on the ALE Reserve, which could affect access to viewing locations. Viewing locations associated with the Columbia River would remain unaffected. The viewshed from the basalt outcrops and from points along the Columbia River could be altered by development of agriculture on the Wahluke Slope and mining and industrial development on other portions of the Hanford Site. Agricultural development of the Wahluke Slope would replace natural vegetation mosaics with ordered rectangular, linear, and circular patterns associated with irrigated cropland and orchards.

Visibility impacts could include fugitive dust from mining and quarrying operations, seasonal releases of particulates from farming activities, releases of fugitive dust from construction sites, and releases of pollutants from new industrial sites.

Noise impacts associated with this alternative could include blasting in support of quarry operations, noise from agricultural machinery, industrial noise in developed areas, and increased noise associated with motorized watercraft on the Columbia River. The new noise sources could affect some areas that are presently quiet, detracting from the recreation experience of recreationists and potentially disrupting wildlife.

Commercial grazing by domestic animals could destroy wetland vegetation, create mud holes, create obnoxious odors, create noise, and be a source of weed and insect pests. Grazing could detract from the recreation experience of recreationists, including hikers, hunters, fishers, and wildlife watchers using areas designated for Low-Intensity Recreation, Conservation, and Preservation; and could disrupt wildlife.

5.2.5.6 Alternative Four. Alternative Four would protect viewing locations at basalt outcrops, on the ALE Reserve, and along the Columbia River. Mining activities in the south-central portion of the Hanford Site could alter viewsheds associated with basalt outcrops. Impacts to visibility could include releases of fugitive dust from construction sites and pollutants from new industrial sites.

Noise impacts under Alternative Four could include blasting during quarry operation, increased noise in the vicinity of new industrial sites, and noise from increased motorized

watercraft use on the Columbia River. The increased noise levels from these activities could detract from the recreation experience of recreationists and could disrupt wildlife.

5.2.5.7 Mitigation Measures. With the exception of the No-Action Alternative, the CLUP policies and implementing procedures described in Chapter 6 would be used to screen development proposals for Hanford Site lands. Proposed projects would be planned to be consistent with the CLUP policies requiring protection of natural and cultural resources. This planning effort would include consideration of aesthetic resources. Potential mitigation measures for aesthetic resources include:

- Implementing dust control measures, such as spraying water or other dust suppressants, on construction, excavation, and quarry sites to reduce emissions of fugitive dust.

- Covering loads when hauling materials away from construction or excavation sites.

- Siting development or mining activities in areas with the least impact on the viewshed from basalt outcrops with their talus slopes, such as Gable Butte and Gable Mountain.

- Minimizing noise impacts to wildlife by restricting activities that generate noise to seasons when sensitive wildlife would be disrupted the least.

- Limiting grazing timing, grazing rotation, and grazing areas to protect aesthetic resources.

5.3 Socioeconomic

5.3.1 Socioeconomic Impacts

The study area used for the purpose of socioeconomics analysis includes Benton, Franklin, and Grant counties.

5.3.1.1 No-Action Alternative. Under the No-Action Alternative, a land-use plan would not be implemented, and facility planning and siting would continue on a project-by-project basis. Because a land-use plan would not guide development, the potential socioeconomic impacts of the No-Action Alternative cannot be readily predicted. The lack of a land-use plan that provides a framework for DOE and local governments to work cooperatively may discourage multiple use and transfer of Hanford lands. In the absence of a land-use plan, it is also unlikely that new recreational opportunities would be developed that would generate economic benefits. However, it can be assumed that this alternative would allow industrial development and R&D activities to occur. Industrial development under the No-Action Alternative is likely to generate more employment than Alternatives One or Two, but probably less employment than would the Preferred Alternative or Alternative Three.

Under the No-Action Alternative, it is less likely facility siting would be coordinated to share utility corridors and conserve space. The lack of a land-use plan could result in inefficient use of existing infrastructure, with new infrastructure added on a project-by-project basis. In the absence of a land-use plan, prioritization of infrastructure maintenance and improvements would be more difficult and could result in higher costs to DOE and local governmental entities responsible for infrastructure.

5.3.1.2 Preferred Alternative. Implementation of the Preferred Alternative would allow industrial development, R&D initiatives, limited mining, and increased recreational uses on Hanford Site

lands. A total of 15,335 ha (37,894 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]), and would provide an additional 13,696 ha (33,844 ac) to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 1,000 or more. Lands under the Research and Development land-use designation would total approximately 4,912 ha (12,138 ac), which could support at least 527,482 m^2 (5.9 million ft^2) of facility space (including buildings, parking lots, and support facilities) and total employment of up to 100 employees.

Future industrial development on Hanford Site lands would require additional support infrastructure, such as roads and utilities. The City of Richland, in its Comprehensive Plan (COR 1997), anticipates industrial development in its UGA[1], which includes Hanford's 300 Area, and a portion of the Hanford Site north of the city limits. The Comprehensive Plan was prepared with the assumption that all industrial development within the 20-year planning period would be accommodated by land already available within the UGA. The Comprehensive Plan describes the city's plans for addressing additional infrastructure needs anticipated in the UGA during the planning period.

The City of Richland's Comprehensive Plan (pp. 3-17, and 3-19 through 3-22) (COR 1997) indicates that growth exceeding the City's projections could result in reduced levels of service in the city's infrastructure, including the transportation system, waste water facilities, water supply, solid waste management, and electrical power supply. If industrial development under the Preferred Alternative expanded beyond the UGA, the development could exceed the City's capacity to provide supporting infrastructure. Existing Hanford Site infrastructure could meet at least some of the increased demand. Improvements to the existing infrastructure may have to be financed through other governmental or public entities, such as Benton County or the Port of Benton, to encourage industrial development on Hanford Site lands.

The Preferred Alternative would make some of the Hanford Site available for mining under the Conservation (Mining) land-use designation. The Preferred Alternative would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company and the filing of new claims for sand and gravel and natural gas development. However, the Preservation land-use designation for the areas of the ALE Reserve surrounding those claims would preclude construction of an access road to the claims, and could make future development economically unfeasible. Mineral development on other areas of the Hanford Site would depend on the release of Hanford Site lands withdrawn from the public domain by DOE, the Bureau of Land Management (BLM), and the BoR. The BoR-held lands on the Wahluke Slope are not subject to mineral claims without the specific agreement of the BoR. The BoR does not anticipate giving permission for extraction of building materials such as sand and gravel from its lands on the Wahluke Slope. Because the restrictions placed on mineral development at the Hanford Site are likely to discourage investment in mining claims, future mineral development is unlikely to have impacts to the regional economy.

The Preferred Alternative would preclude basalt quarrying from basalt outcrops and soil mining from the McGee Ranch. These locations have been identified as the most cost-effective and technically feasible sources of geologic materials for remediation (see Appendix D). The Conservation (Mining) land-use designation under the Preferred Alternative designates an area in the ALE Reserve as an alternative basalt source. Alternative soil mining sites are also available under the Conservation (Mining) land-use designation. Increased haul distances from quarries to remediation sites would increase remediation costs under the Preferred Alternative, as compared to the No-Action Alternative and Alternative Three.

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[1] An urban growth area (UGA) is defined as an area designated by the county or city for the expansion of urban development and municipal jurisdiction.

Low-Intensity Recreation associated with the Vernita Terrace, and High-Intensity Recreation use associated with boat launches and the B Reactor Museum, along with limited recreational opportunities under the Conservation and Preservation land-use designations, could have impacts on the economy in the study area. Because current access to the Columbia River Corridor is effectively limited to the Wahluke Wildlife Recreation Area, increased access under the Preferred Alternative could greatly increase use for sport fishing, recreational boating, and other day uses. Assuming that increased access to the Columbia River Corridor would double the amount of day use over levels at the Wahluke Wildlife Recreation Area, an additional $1.4 million per year could be generated for the local economy in recreational tourism dollars. Increased recreational use could increase employment in retail sporting goods, boat dealers, recreational vehicle (RV) dealers, and hotels and motels in the study area. These service industry jobs typically benefit the economically disadvantaged worker by providing more job opportunities.

5.3.1.3 Alternative One. Implementation of Alternative One would expand the existing Saddle Mountain NWR. According to the Washington Department of Fish and Wildlife (WDFW), wildlife viewing is big business in Washington State. More than a third of the state's population participates in wildlife viewing and those wildlife watchers spent nearly $1.7 billion on the pursuit in Washington in 1996. A report issued by the WDFW entitled, *The Economic Benefits of Wildlife-Watching Activities in Washington*, found that wildlife watchers spent $1.1 billion on equipment purchases; $509 million on trip-related expenses including food and lodging; $106 million for land-use fees and rentals; and $59 million for items such as magazines, books, membership dues, and other items. Nationwide, Americans spent $29.2 billion on wildlife in 1996 and if wildlife-watching were a company, nationally it would have ranked 23rd among Fortune 500 corporations. In Washington alone, wildlife-viewing activities in 1996 translated to nearly 8,000 jobs, sales tax of $56.9 million, and destination tourism drawing about 270,000 out-of-state visitors who spent nearly 6 million visitor-days. How much income the expanded refuge would bring to the Hanford area is unknown at this time.

Alternative One would allow continued industrial development and limited recreational uses on Hanford Site lands. A total of 2,542ha (6,281 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]), and would provide an additional area to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 100 to 1,000. Research and Development land uses would be limited to the 300 Area and 400 Area, which are already developed. The economic impact of Research and Development land use under Alternative One would depend on possible future uses for the 300 and 400 Areas facilities.

Alternative One would allow efficient use of existing infrastructure located in the 300 Area and in the City of Richland UGA, but could require new infrastructure to develop the rectangular area located south of the Energy Northwest (formerly known as WPPSS) site designated for industrial use. This area is an "island" surrounded by lands designated Preservation, which could make extension of utilities to the area difficult. Construction of utility corridors through Preservation lands would require more project reviews and justification, resulting in increased costs and extended schedules. Because Alternative One would convert other areas containing existing infrastructure to the Preservation land-use designation, the existing infrastructure would not be maintained and would lose its remaining economic value.

Alternative One would expand an existing Federal wildlife refuge. Because a wildlife refuge would be expected to maintain high ecological values, there are various legal requirements attached by the Federal and state governments that could have socioeconomic impacts. A summary of possible socioeconomic impact drivers by resource area follows.

- **Air** -- For visibility protection, the *Clean Air Act of 1977* specifies that Federal wildlife refuges over 10,000 acres can only be designated as Federal Class I or Federal Class II air shed (CAA Section 162 and WAC 173-400).

- **Land** -- Any Dangerous Waste Management Unit boundary must be sited at least one-quarter mile from state or federally designated wildlife refuges (WAC 173-303-282); and, incinerator ash disposal facilities shall not be located in a state or federally designated wildlife refuge (WAC 173-306-350).

- **Surface water** -- No degradation of existing sediment quality shall be allowed of waters constituting an outstanding national resource, such as water of a wildlife refuge (WAC 173-204-120).

- **Groundwater** -- Degradation shall not be allowed of high quality ground waters constituting an outstanding national or state resource such as waters of a wildlife refuge (WAC 173- 200-030)

Alternative One would reduce the amount of land designated Industrial-Exclusive as compared to the No-Action Alternative, the Preferred Alternative, and Alternatives Three and Four. This could limit future development of lands under this designation for future DOE missions, and could have impacts on the future economic contribution of DOE activities. However, GIS data indicate that only 38 percent of lands under this designation are currently developed. Also, none of the reasonably foreseeable actions identified for the 200 Areas would require lands that would not be available under Alternative One, indicating that sufficient lands would remain available under the Industrial-Exclusive land-use designation to support future development without adverse socioeconomic impacts.

Alternative One would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company, but would not allow the filing of new claims for sand and gravel and natural gas development. Mining on the Hanford Site would be limited to obtaining geologic materials to support remediation and maintaining existing sand and gravel quarries. These mining activities are unlikely to have economic impacts in the study area.

Alternative One would allow High-Intensity Recreational uses at the B Reactor and Vernita Bridge, where a new boat ramp would be constructed. Another unimproved boat ramp and other Low-Intensity Recreational uses would also be allowed. Recreation under this alternative is likely to have the greatest economic impact directly from ecotourism as a result of the expansion of the existing Saddle Mountain NWR.

5.3.1.4 Alternative Two. Implementation of Alternative Two would allow limited industrial development and limited recreational uses on Hanford Site lands. This alternative would have the least economic potential of the alternatives being considered. A total of 1,830 ha (4,522 ac) would become available for industrial development, which is 191 ha (472 ac) more than the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]). However, much of this land (which includes the Energy Northwest [formerly WPPSS], FFTF, and lands adjacent to the city of Richland), is already developed. According to the GIS database, 673 ha (1,662 ac) or 32 percent of the Industrial land-use designation under Alternative Two is already developed. Therefore, this alternative would not have sufficient vacant land to meet the estimated future need or provide for possible future DOE missions.

The relatively small amount of vacant land designated for Industrial development under this alternative would probably limit new industrial employment to less than 100. Research and Development land uses under this alternative would be limited to existing uses at LIGO (theoretical physics research), and the K Reactor Basins (aqua-culture). The number of employees that could be supported would depend on possible future uses of these facilities. As was described

under Alternative One, Alternative Two would reduce the area available for development under the Industrial-Exclusive land-use designation but is unlikely to have adverse socioeconomic impacts.

As with the Preferred Alternative, Alternative Two would allow commercial development of the existing natural gas claim on the ALE Reserve, but the Preservation land-use designation would limit access. This alternative would preclude the development of any other geologic resources on the Hanford Site. Geologic resources required to support remediation activities would have to be obtained from locations off the Hanford Site, which could increase remediation costs (see Appendix D).

Alternative Two would allow High-Intensity Recreation associated with the B Reactor Museum, but would not increase recreational access to the river. Day use of the B Reactor area would generate some economic benefits, but they would be substantially less than those estimated for the recreational uses under the other alternatives.

As in Alternative One, an additional economic benefit may be realized from the Preservation land-use designation, which could increase interest in the Hanford Site in the ecotourism market. Interest in ecotourism, which focuses on pristine habitats and rare species, is increasing. The preserved habitats and associated species at the Hanford Site could draw additional visitors to the Site, and generate additional revenues. However, access would be limited under Alternative Two and the Preservation areas would lack the additional legal protection of being a NWR.

5.3.1.5 Alternative Three. Under Alternative Three, a total of 17,860 ha (44,133 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]), and would provide an additional 16,221 ha (40,083 ac) to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 1,000 or more. Industrial development on the Hanford Site could increase infrastructure demand, as described under the Preferred Alternative.

Lands under the Research and Development land-use designation would total approximately 8,177 ha (20,206 ac), of which approximately 20 percent would be occupied by infrastructure, such as roads and utility corridors. The remaining land base would support at least 878,000 m^2 (9.7 million ft^2) of facility space and total employment of 100 to 300 employees.

As with the Preferred Alternative, Alternative Three would allow the efficient use of existing infrastructure on the Hanford Site, but could generate increased demand that could exceed the capacity of the City of Richland. Improvements to the existing infrastructure may have to be financed through other governmental or public entities, such as Benton County or the Port of Benton, to encourage industrial development on Hanford Site lands.

Alternative Three would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company, and the filing of new claims for sand and gravel and natural gas development. The Conservation (Mining) land-use designation on the ALE Reserve would allow access to develop the existing natural gas claim, pending review and issuance of a special-use permit, as described in Chapter 6. Alternative Three is more likely to result in development of the existing natural gas claim than would the other alternatives being considered, and could encourage further development of natural gas resources on and near the Hanford Site. Mineral development on other areas of the Hanford Site would depend on the release of Hanford Site lands withdrawn from the Public Domain, as described under the Preferred Alternative.

Alternative Three would not preclude basalt quarrying, if permitted by DOE, from basalt outcrops such as Gable Mountain and Gable Butte, and soil mining from the McGee Ranch.

These locations have been identified as the most cost-effective and technically feasible sources of geologic materials for remediation (see Appendix D). Alternative Three could reduce remediation costs compared to the Preferred Alternative and Alternatives One, Two, and Four.

Alternative Three would allow cultivated agriculture, industrial development, R&D initiatives, limited commercial grazing and mining, and High-Intensity Recreational uses within designated areas of the Hanford Site. This alternative would have the highest potential for economic development of the alternatives being considered. Under this alternative, lands on the Wahluke Slope could be developed for growing irrigated crops, including small grains, potatoes, hay, fruits, and vegetables, as well as livestock production. The economic impact of agricultural development on former Hanford Site lands would depend on how much land is converted to farmland, how much is irrigated, and what crops are grown. Table 5-12 summarizes the potential economic impacts of agricultural development under several scenarios. Under these scenarios, the total market value of agricultural products in the three counties could increase from 1.7 to 9.4 percent, corresponding to a range of $16 million to $88 million (using 1992 prices) in additional revenues. This potential increase does not take into account the affect of increasing production on the market for agricultural commodities. Alternative Three would allow livestock grazing on 6,476 ha (16,003 ac) of the Wahluke Slope, increasing the total pasture land base in the three counties by 2.5 percent. This acreage could support approximately 1,059 AUM, with a value of approximately $12,700.

High-Intensity Recreational development of the Vernita Terrace under Alternative Three may include a destination resort with golf course, a boat launch, Tribal fishing facilities, interpretive exhibits, and the B Reactor Museum. A destination resort and conference center featuring a 350-unit hotel, RV parking, and a golf course could employ 200 to 400 persons. By comparison, hotels and motels in the study area employed approximately 900 persons with a total payroll of approximately $9.4 million in 1995. A large destination resort located at Vernita Terrace could generate an additional $2 million to $4 million in payroll, in addition to other revenues. However, these possible benefits could have negative impacts on other hotels, motels, and resorts in the area. In addition, a destination resort development at Vernita Terrace could also require additional investment in infrastructure in the northwestern portion of the Hanford Site.

If future recreational developments under Alternative Three do not include a destination resort, other developments could contribute to the economy. An RV park containing 100 spaces and operating at 80 percent capacity for 200 days per year could generate approximately $1.3 million annually. A golf course serving 150 golfers per day and operating year-round could generate approximately $1.4 million annually. Increased access to the Columbia River Corridor under this alternative could also generate revenues from sport fishing and other day uses that would be similar to those estimated for the Preferred Alternative.

5.3.1.6 Alternative Four. Implementation of Alternative Four would allow continued industrial development, R&D initiatives, limited mining, and recreational uses on former Hanford Site lands. Alternative Four would increase the land base available for industrial and Research and Development land uses in Benton County. A total of 6,881 ha (17,003 ac) would become available for industrial development, which would meet the estimated need forecasted by the Benton County Planning Department (1,639 ha [4,050 ac]) and would provide an additional 5,242 ha (12,953 ac) to support possible future DOE missions. This amount of land would allow the siting of several manufacturing facilities, with a total employment of 100 to 1,000. Lands under the Research and Development land-use designation would total 4,388 ha (10,843 ac), which could support at least 522,000 m^2 (5.8 million ft^2) of facility space and total employment of up to 100 employees.

Table 5-12. Potential Economic Impacts of Agricultural Development.

Agricultural Economic Indicators for the Three-County Study Area	Scenario 1: Crop Mix with Grazing in Red Zone[a]	Scenario 2: Crop Mix Without Red Zone	Scenario 3: Specialty Crop Production with Grazing in Red Zone
	Percent Increase over Existing Conditions		
Agricultural land	2.5%	2.5%	2.5%
Cropland	2.1%	3.7%	2.1%
Irrigated land	4.5%	8.0%	4.5%
Land in vegetable crops	4.5%	8.0%	24%
Land in fruit orchards	4.5%	8.0%	24%
Pastureland	4.1%	0%	4.1%
Total market value of agricultural products	1.7%	3.0%	9.4%
Total market value of crops	2.1%	3.7%	12%
Total market value of livestock	4.1%	0%	4.1%
Total market value of specialty crops	4.5%	8.0%	24%

a Red Zone refers to areas on the Wahluke Slope that may contribute to sloughing of the White Bluffs if used for agricultural purposes.

As with the Preferred Alternative, Alternative Four would allow the efficient use of existing infrastructure on the Hanford Site, but could generate increased demand that could exceed the capacity of the City of Richland. Improvements to the existing infrastructure may have to be financed through other governmental or public entities, such as Benton County or the Port of Benton, to encourage industrial development on Hanford Site lands.

Alternative Four would allow the development of the existing natural gas claim held by the Big Bend Alberta Mining Company, but would not allow the filing of new claims for sand and gravel and natural gas development. As with the Preferred Alternative, Alternative Four would limit access to the existing natural gas claim on the ALE Reserve. Mining elsewhere on the Hanford Site would be limited to obtaining geologic materials to support remediation. These mining activities are unlikely to have economic impacts in the study area.

Alternative Four would provide increased boating access to the Columbia River by adding two new access points to the river at White Bluffs and Vernita Bridge. Recreation under this alternative is likely to have economic impacts such as increased revenues and employment, but these impacts would probably be less than those described for the Preferred Alternative.

5.4 Environmental Justice

The following discussion addresses environmental justice as related to the land-use alternatives being considered for the Hanford Site. Minority and low-income populations in the vicinity of the Hanford Site are identified, followed by a discussion of the impacts that the alternatives might have on these populations. Analysis of environmental justice concerns was based on a qualitative assessment of the impacts reported in other sections of Chapter 5. The analysis was performed to identify any disproportionately high and adverse human health or environmental impacts on minority or low-income populations within the zone of potential impact, and for tribal members that are beyond the 80 km (50 mi) radius from the 200 East Area but have reserved treaty rights on the Hanford Site. The evaluation considered potential impacts arising

under each of the major impact categories evaluated in this EIS, including socioeconomics, water resources, air resources, ecology, health and safety, and cultural resources.

5.4.1 Demographic Analysis

Demographic information obtained from the U.S. Bureau of Census was used to identify minority populations and low-income communities within an 80-km (50-mi) radius surrounding the 200 East Area on the Hanford Site at the census block group level (Neitzel et al. 1997). For the evaluation of environmental justice impacts, the area defined by this 80-km (50-mi) radius was considered the zone of potential impact.

A total population of approximately 384,000 people reside within an 80-km (50-mi) radius of the Hanford Site. The minority population within the area of impact consists of approximately 95,000 people and represents approximately 25 percent of the population in the assessment area. The ethnic composition of the minority population is primarily Hispanic (approximately 80 percent) and American Indian (8 percent). Census block groups where the percentage of minority persons within the population exceeds 25 percent are primarily located to the southwest and northeast of the Hanford Site and within the City of Pasco, Washington (Neitzel et al. 1997). However, several large census block groups (i.e., areas with low population density) with populations consisting of between 25 and 50 percent minority persons border the Hanford Site on the west, north, and east.

The low-income population within the 80-km (50-mi) area of impact represents approximately 42 percent of households in the area of impact. Census block groups where the percentage of the population below the poverty level exceeds 20 percent are principally located to the southwest and north of the Hanford Site and within the City of Pasco, Washington (Neitzel et al. 1997).

5.4.2 American Indian Populations Near the Hanford Site

Substantial American Indian populations are located within the 80-km (50-mi) assessment area. Census block groups within the assessment area and composed primarily of American Indian populations are primarily located on the Yakama Indian Reservation in Yakima County, Washington. However, other American Indian populations located outside of the assessment area also have an interest in the Hanford Site based on treaty rights (see Appendix A). Treaty reserved Tribal fishing rights have been recognized as effective within the Hanford Reach. The Tribes also have an interest in renewing traditional uses, such as gathering of foods and medicines, hunting, and pasturing horses and cattle on Hanford Site lands (Yakama Nation, June 1, 1998, DOE CCN 059113).

Future opportunities of the tribal members to exercise reserved treaty rights are dependent upon the health of the ecosystems. The Tribes assert that a treaty right to hunt, fish, or gather plants is diminished (if not voided) if the fish, wildlife, or plants have vanished or are contaminated to the extent that they threaten human health. These resources, particularly the resources with cultural and religious connotations, do not have equivalent value for the general population.

5.4.3 Human Health Impacts

Although adoption of a land-use plan for the Hanford Site would not have any direct impacts on human health, each of the alternatives could indirectly affect human health, depending on the land uses that are implemented. The contamination left at depth poses a potential hazard to development.

Even facilities associated with Low-Intensity Recreation may increase human health risk by increasing infiltration of natural precipitation above the expected parameters used in the CERCLA risk estimation. Where vegetation is suppressed and ground covers are used (i.e., campgrounds), infiltration of precipitation could occur at a higher rate driving contaminants toward groundwater, unless the increase in activities also increases soil compaction. Soil compaction caused by camping activities could actually reduce the rate of infiltration in some areas by reducing the number and size of water infiltration pathways in the soil.

The recently completed *Screening Assessment and Requirements for a Comprehensive Assessment, Columbia River Comprehensive Impact Assessment* (CRCIA) (DOE 1998a) evaluated both chemical and radiological health risk potential for a variety of Hanford Site use scenarios. This assessment focused on the Columbia River and riparian zone and included several Native American subsistence scenarios (e.g., subsistence resident, upland hunter, river-focused hunter and fisher, gatherer of plant materials, and Columbia River island users). These Native American scenarios were developed by a Native American representative on the CRCIA team specifically for the CRCIA effort[1]. Environmental measurements used for the CRCIA analysis were based on data collected under DOE's environmental monitoring program from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup.

Even these current monitoring program data do not indicate that adverse health risks would be associated with consumption of fish and game. The radiation dose received by a person who subsisted on wild game and fish would be higher than the 2.2×10^{-3} mrem reported as the "Sportsman Dose" in the *Hanford Site Annual Environmental Report* by Pacific Northwest National Laboratory (PNNL). However, this incremental dose to natural background of approximately 300 mrem would be unlikely to be sufficiently high to cause adverse health effects.

In the CRCIA Native American scenarios, people were assumed to live along the Columbia River, to eat substantial quantities of food grown in the riparian zone, to eat fish and wildlife from the river, and to drink seep water. These people who live a subsistence lifestyle linked to a specific location would have a much larger potential exposure and, thus, estimated health risk than other people who are more mobile and can trade for other food sources. Lifetime health risks greater than 1×10^{-4} [1 in 10,000] were found for many sections of the river for potential exposure to chromium, copper, strontium-90, uranium-238, lead, and tritium. However, the source of the nonradioactive heavy metals (particularly copper and lead) may be from historic mining operations upstream of Hanford (e.g., copper, silver, and gold mining in Idaho's Clearwater River drainage). According to these analyses, potentially increased health risk is possible if people were to move onto the Hanford Site and derive a large percentage of their daily food intake from crops and animals grown or taken in the river's riparian zone. In most cases, this higher risk is limited in extent to a few regions of highest contamination. Although many cultural differences exist in the relative percentages of food types between the general population and Native American populations, the common pathways of food and water consumption would affect both groups.

Land-use designations such as Preservation, Conservation, Low-Intensity Recreation, Industrial, and Research and Development are unlikely to contribute to increased health risk from residual contamination because the current CERCLA RODs are written to either industrial or residential exposure times and pathways. However, increased human health risk could be associated with Agriculture and High-Intensity Recreation uses if the CLUP policies and implementing procedures are not implemented with the land use designations.

[1] These scenarios are not the same as scenarios commonly used for determining health impacts at Hanford.

Adoption of a land-use plan for the Hanford Site could have direct impacts on human health depending on the land uses that are implemented because of the associated changes in types and durations of activities associated with a land-use designation (Table 5-13). For example, currently the Hanford Site is used for Federal industrial activities. The Hanford Site has an average annual fatality rate of 2.8 per 100,000 workers. The national average annual fatality rate for private industry is 5.1 per 100,000 workers. The transfer jobs from the government to the private sector statistically doubles the fatality risk for the average worker. By race, white workers average annually 4.6 fatalities per 100,000 workers, black workers average annually 4.5 fatalities per 100,000 workers and hispanic workers average annually 5.3 fatalities per 100,000 workers (Table 5-13).

5.4.4 No-Action Alternative

Access restrictions would remain in effect under the No-Action Alternative and the potential for health risks would be comparable to existing risk. Use of the Columbia River for recreation would continue at levels comparable to current use. Minority or low-income individuals may be more prone to use this resource for subsistence than might members of the general population. Current uses of the Columbia River are not known to cause disproportionately high and adverse human health impacts in any population and no such impacts would be expected to occur as a result of the No-Action Alternative.

Development of Hanford Site lands would not be restricted by land-use designations under the No-Action Alternative. Cultural resources of importance to American Indians located on the Hanford Site, including Gable Butte and Gable Mountain, could be developed under this alternative. The availability of these resources for development represents a potential environmental justice impact to American Indians.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities. Consequently, the current management of the Wahluke Slope would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.4.5 Preferred Alternative

The Preferred Alternative would allow for increased access to Hanford Site lands and to the Columbia River for Tribal members by allowing a High-Intensity Recreation Tribal fishing camp at the White Bluffs boat launch on the Franklin County side (north) of the river and by allowing a High-Intensity Recreation Tribal fishing camp near B Reactor on the Grant County side (north) of the river. Private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

As described in CRCIA (DOE 1998a), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase

Table 5-13. Annual Occupational Fatality Rates for Selected Occupations (1996). (3 pages)

Number, percent, and rate of potential fatal occupational injuries by selected worker characteristics, industry, and occupation, 1996.

Characteristic	Fatalities		Employed[1] (thousands)	Fatalities per 100,000 workers[2]	Relative Standard error[3] (percent)
	Number	Percent			
TOTAL	**6,112**	**100**	**127,997**	**4.8**	**.2**
Employee Status					
Wage and salary workers	4,905	80	117,329	4.2	.2
Self-employed	1,207	20	10,668	11.1	1.1
Gender					
Men	5,605	92	69,329	8.1	.3
Women	507	8	58,668	0.9	.4
Age					
Under 16 years	27	--	--	--	--
16 to 17 years	43	1	2,648	1.6	2.2
18 to 19 years	124	2	3,941	3.1	1.8
20 to 24 years	440	7	12,532	3.5	1.0
25 to 34 years	1,336	22	32,579	4.1	.6
35 to 44 years	1,563	26	35,319	4.4	.5
45 to 54 years	1,226	20	25,550	4.8	.6
55 to 64 years	847	14	11,741	7.2	1.0
65 years and over	492	8	3,690	13.3	1.8
Not reported	14	--	--	--	–
Race					
White	5,047	83	108,805	4.6	.2
Black	617	10	13,789	4.5	.9
American Indian, Eskimo, and Aleut	35	1	--	--	--
Asian and Pacific Islander	163	3	--	--	--
Other	91	1	--	--	--
Not reported	159	3	--	--	–
Hispanic origin					
Hispanic	626	10	11,725	5.3	1.0
Industry					
PRIVATE INDUSTRY	**5,521**	**90**	**108,472**	**5.1**	**.2**
Agriculture, forestry, and fishing	798	13	3,505	22.2	1.9
Agricultural production, crops	335	5	1,025	31.3	3.5
Agricultural production, livestock	154	3	1,214	12.2	3.2
Agricultural services	171	3	1,189	14.3	3.2
Fishing, hunting and trapping	73	1	53	137.7	15.4
Mining	152	2	567	26.8	4.7
Coal mining	39	1	98	39.8	11.3
Oil and gas extraction	82	1	302	27.2	6.5
Construction	1,039	17	7,464	13.9	1.3
Manufacturing	715	12	20,434	3.5	.7
Food and kindred products	70	1	1,706	4.1	2.7
Lumber and wood products	203	3	794	25.6	4.0
Transportation and public utilities	947	15	7,248	13.1	1.3
Local and interurban passenger transit	78	1	503	15.5	5.0
Trucking and warehousing	511	8	2,451	20.8	2.3
Transportation by air	113	2	778	14.5	4.0
Electric, gas, and sanitary services	88	1	1,066	8.3	3.4

Table 5-13. Annual Occupational Fatality Rates for Selected Occupations (1996). (3 pages)

Number, percent, and rate of potential fatal occupational injuries by selected worker characteristics, industry, and occupation, 1996.

Characteristic	Fatalities		Employed[1] (thousands)	Fatalities per 100,000 workers[2]	Relative Standard error[3] (percent)
	Number	Percent			
Wholesale trade	267	4	4,942	5.4	1.6
Retail trade	672	11	21,443	3.1	.7
Food stores	173	3	3,507	4.9	1.9
Automotive dealers and service stations	98	2	2,165	4.5	2.4
Eating and drinking places	166	3	6,483	2.6	1.4
Finance, insurance, and real estate	114	2	7,862	1.5	1.2
Services	767	13	35,008	2.2	.5
Business services	168	3	5,680	3.0	1.5
Auto repair, services, and parking	103	2	1,618	6.4	2.8
Not reported	50	1	--	--	–
GOVERNMENT	**591**	**10**	**19,525**	**3.0**	**.8**
Federal	178	3	4,583	3.9	1.6
State	127	2	5,150	2.5	1.5
Local	284	5	9,791	2.9	1.1
Managerial and professional specialty occupations	711	12	36,497	1.9	.5
Executive, administrative, and managerial occupations	437	7	17,746	2.5	.8
Managers, food serving and lodging establishments	75	1	1,383	5.4	3.0
Professional specialty	274	4	18,752	1.5	.8
Technical, sales, and administrative support occupations	761	12	37,683	2.0	.5
Technicians and related support occupations	163	3	3,926	4.2	1.8
Airplane pilots and navigators	100	2	114	87.7	10.5
Sales occupations	503	8	15,404	3.3	.9
Supervisors and proprietors, sales occupations	225	4	4,501	5.0	1.7
Cashiers	94	2	2,856	3.3	2.1
Administrative support occupations, including clerical	95	2	18,353	0.5	.8
Messengers	8	--	175	4.6	8.5
Service occupations	492	8	17,177	2.9	.8
Protective service occupations	248	4	2,187	11.3	2.4
Fire fighting and fire prevention occupations[4]	37	1	270	13.7	6.8
Police and detectives	114	2	1,057	10.8	3.4
Guards	97	2	859	11.3	3.8
Farming, forestry, and fishing occupations	883	14	3,566	24.2	1.9
Farm occupations	569	9	2,212	24.8	2.4
Groundskeepers and gardeners, except farm	90	1	875	10.3	3.8
Forestry and logging occupations	134	2	108	124.1	10.8
Timber cutting and logging occupations	118	2	75	157.3	13.0
Fishers, hunters, and trappers	72	1	49	146.9	16.0
Fishers[5]	72	1	47	153.2	16.4
Precision production, craft, and repair occupations	1,072	18	13,587	7.9	.9
Mechanics and repairers	282	5	4,521	6.2	1.6
Automobile mechanics and apprentices	35	1	889	3.9	3.8
Heavy equipment mechanics	38	1	156	24.4	9.0
Construction trades	592	10	5,108	11.6	1.5
Carpenters and apprentices	87	1	1,220	7.1	3.2
Electricians and apprentices	98	2	763	12.8	4.1
Electrical power installers and repairers	38	1	126	30.2	10.0
Painters, construction and maintenance	45	1	504	8.9	5.0

Table 5-13. Annual Occupational Fatality Rates for Selected Occupations (1996). (3 pages)

Number, percent, and rate of potential fatal occupational injuries by selected worker characteristics, industry, and occupation, 1996.

Characteristic	Fatalities		Employed[1] (thousands)	Fatalities per 100,000 workers[2]	Relative Standard error[3] (percent)
	Number	Percent			
Plumbers, pipefitters, steamfitters, and apprentices	32	1	555	5.8	4.8
Roofers	61	1	197	31.0	8.0
Structural metal workers	52	1	61	85.2	14.4
Extractive occupations	87	1	130	66.9	9.8
Drillers, oil wells	22	--	22	100.0	23.9
Mining machine operators	28	--	39	71.8	18.0
Operators, fabricators, and laborers	2,006	33	18,197	11.0	.8
Machine operators, assemblers, and inspectors	218	4	7,874	2.8	1.2
Welders and cutters	62	1	605	10.2	4.6
Transportation and material moving occupations	1,154	19	5,302	21.8	1.5
Motor vehicle operators	913	15	4,025	22.7	1.7
Truck drivers	785	13	3,019	26.0	2.0
Drivers-sales workers	35	1	156	22.4	9.0
Taxicab drivers and chauffeurs	65	1	203	32.0	7.9
Water transportation occupations	42	1	69	60.9	13.5
Sailors and deckhands	33	1	25	132.0	22.5
Material moving equipment operators	177	3	1,093	16.2	3.4
Operating engineers	38	1	245	15.5	7.2
Excavating and loading machine operators	26	--	92	28.3	11.7
Industrial truck and tractor equipment operators	46	1	512	9.0	5.0
Handlers, equipment cleaners, helpers, and laborers	634	10	5,021	12.6	1.6
Construction laborers	291	5	809	35.7	3.9
Garbage collectors	21	--	43	48.8	17.1
Laborers, except construction	213	3	1,334	15.9	3.1
Military	123	2	1,289	9.5	--
Not reported	64	1	--	--	--

[1] The employment figures, except for military, are annual average estimates of employed civilians 16 years of age and older, from the Current Population Survey (CPS 1996). The resident military figure, derived from resident and civilian population data from the Bureau of the Census, was added to the CPS employment total.

[2] The rate represents the number of fatal occupational injuries per 100,000 employed workers and was calculated as follows: (N/W) x 100,000, where N = the number of fatal work injuries, and W = the number of employed workers, as described in the previous footnote. There were 27 fatally injured workers under the age of 16 years that were not included in the rate calculations to maintain consistency with the CPS employment.

[3] The relative standard errors of the CPS employment estimates can be used to approximate confidence ranges for the fatality rates. For example, a confidence range for the roofers rate can be approximated as follows: 31.0 x .08 x 1.6 = 4.0, where 31.0 = the rate, .08 = the relative standard error (8.0 percent), and 1.6 = the factor for a 90 percent confidence level. The confidence range for this rate is 27.0 to 35.0 (31.0 plus or minus 4.0).

[4] Includes supervisors.

[5] Includes captains and other officers.

NOTE: The rates are experimental measures using CPS employment. Selected rate categories had 20 or more reported work injury fatalities in 1996 and 20,000 or more employed workers. Dashes indicate data not available or less than .5 percent. Totals for major categories may include subcategories not shown separately. Figures may not add to totals because of rounding.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Census of Fatal Occupational Injuries, 1996.

the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and therefore any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence,

would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures.

The Preferred Alternative would designate Gable Mountain, Gable Butte, and other areas of cultural value to American Indians for Preservation. This designation would eliminate the potential for disproportionately high and adverse impacts due to development of culturally significant areas. The Preferred Alternative would allow development within the viewscape of these high promontories. Alteration of these viewscapes would represent a potential environmental justice impact to American Indians.

The Preferred Alternative would allow economic development of Hanford Site lands. Low-income populations in the vicinity of the Hanford Site would benefit from increased economic activity and growth in community services that could occur as a result of development. However, economic development could increase the demand for housing and tend to decrease the availability of low-income housing. In spite of these conflicting impacts, low-income populations in communities that are influenced by development at the Hanford Site would probably benefit from the development. Low-income communities located to the north and west of the Hanford Site historically have not been strongly influenced by Hanford Site activities and the affects of future development would probably be neutral in these communities.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities and have a higher average annual fatality rate of 31.3 fatalities per 100,000 workers (Table 5-13). Additionally, increased access to the Columbia River would allow more | fishing which has a high average annual fatality rate of 153 fatalities annually per 100,000 workers.| The Preferred Alternative would be unlikely to result in disproportionately high and adverse socioeconomic impacts to low-income or minority populations.

5.4.6 Alternative One

With the expansion of the existing Saddle Mountain NWR, more restrictions could be placed on the consumptive use of natural resources. These restrictions placed to preserve the natural resources could impact the exercise of treaty reserved rights that by their nature (e.g., hunting, fishing, pasturing of livestock etc.) consume the natural resources. Private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

Alternative One would allow increased access to Hanford Site lands and to the Columbia River. As described in CRCIA (DOE 1998a), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not

assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures.

Alternative One would limit development primarily to previously disturbed areas and to areas of low habitat quality (BRMaP Levels I and II). This limitation to development could constrain economic development in the vicinity of the Site, which would potentially affect low-income individuals and communities to a greater degree than it would potentially affect the general population. These impacts could include declining community services or increased taxes which could place an greater burden on low-income households and communities than on the population in general. This burden represents a potential disproportionately high socioeconomic impact; however, most low-income communities within the analysis area are not greatly influenced by development activities at the Site.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities. Consequently, Alternative One would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.4.7 Alternative Two

Alternative Two would designate the majority of the Hanford Site for Preservation, and would allow development in previously developed areas and in an area immediately north of the city of Richland. The major difference between Alternative Two and Alternative One is that Alternative Two would lack the Federal designation of wildlife refuge and therefore those natural resources would not be considered “taken” because they had Federal protection greater than normally found on Public Domain lands. Alternative Two would ensure that tribal treaty rights could be enjoyed under the limits of the Preservation designation. Alternative Two would protect cultural resources from Mining, and utilization of geologic resources on the Hanford Site would not be allowed under this alternative. Economic development of Hanford Site land and resources would be held to a minimum under this alternative.

Alternative Two would allow increased access to Hanford Site lands and to the Columbia River. As described in CRCIA (DOE 1998), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures.

Alternative Two would also minimize access to the Hanford Site through the Preservation designation. This limited access would minimize the potential for environmental justice impacts to American Indians that could occur as a result of potential damage to cultural and biological resources under other alternatives.

Limitations to economic development under this alternative would potentially impact low-income populations in the vicinity of the Hanford Site. These impacts could include declining community services or increased taxes, which could in turn place an greater burden on low-income households and communities than on the population in general. This burden represents a potential disproportionately high socioeconomic impact; however, most low-income communities within the analysis area are not greatly influenced by development activities at the Site.

Prohibiting development of agriculture on the Wahluke Slope would also potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are not high wage opportunities. Consequently, the Preservation designation for the Wahluke Slope would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.4.8 Alternative Three

Alternative Three would allow increased access to Hanford Site lands and to the Columbia River. As described in CRCIA (DOE 1998), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures. Independent of risk due to residual contamination, private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

Activities associated with Alternative Three, such as agriculture, could result in damage to cultural and biological resources of value to American Indian Tribes. Furthermore, if permitted by DOE, Gable Butte and Gable Mountain could be available for development of quarries and mining activities could be undertaken within the viewsheds of these high promontories. Disturbance of the promontories or their viewsheds would be a disproportionately high and adverse environmental impact to American Indians.

Alternative Three would allow for the maximum potential for economic development of Hanford Site lands. Low-income populations in the vicinity of the Hanford Site would benefit from increased economic activity and growth in community services that could occur as a result of development. However, economic development could increase the demand for housing and tend to decrease the availability of low-income housing. In spite of these conflicting impacts, low-

income populations in communities that are influenced by development at the Hanford Site would probably benefit from the development.

Allowing agriculture on the Wahluke Slope would potentially provide a benefit to low-income and minority populations located to the north of the Hanford Site by providing the potential for new jobs in those areas. Many jobs associated with current agricultural practices are not high wage opportunities and relatively dangerous with an average annual fatality rate of 31.3 fatalities per 100,000 workers (Table 5-13), but increases in economic opportunities could be expected to benefit local communities, including low-income and minority populations by increasing access to health care and educational opportunities. Infrastructure costs would increase in proportion to the number of low-wage jobs created and filled from outside the area. Disproportionately high and adverse socioeconomic impacts to low-income or minority populations would be unlikely under Alternative Three.

5.4.9 Alternative Four

Alternative Four would allow for increased access to Hanford Site lands and to the Columbia River for Tribal members by allowing a High-Intensity Recreation Tribal fishing camp at the White Bluffs boat launch on the Benton County side (south) of the river.

As described in CRCIA (DOE 1998), increased use and access to the Hanford Site would potentially increase exposure time to contaminated plants, air, soil, and water; and, therefore, could also potentially increase health risk. This access would also provide increased opportunity for subsistence consumption of fish taken from the Columbia River which could, in turn, increase the potential for adverse health effects from fish that have resided in contaminated water. As a percentage of their population, minority or low-income individuals may be more prone to adopt a subsistence lifestyle than might members of the general population and, therefore, any health impact would be disproportionate to the minority population. Avid sportsmen among the general population also could have an increased risk of health effects from increased exposure but would represent a smaller percentage of their population. Environmental measurements used for the CRCIA analysis were based on data collected from 1990 through 1996 and, as a consequence, would not necessarily reflect the future condition of the Hanford Site, as these scenarios do not assume cleanup. Therefore, although the CRCIA analyses used an increased access to and use of the Hanford Site as a basis for estimating health effects, the increased access due to this alternative is not expected to result in disproportionately high and adverse health effects in minority or low-income populations because of the institutional protections provided by the CLUP policies and implementing procedures. Independent of risk due to residual contamination, private fishing, hunting and trapping activities have one of the highest fatal accident rates at 137.7 fatalities per 100,000 workers (Table 5-13).

Alternative Four would designate most of the Hanford Site for Preservation and this designation would serve to protect cultural and biological resources of importance to American Indian Tribes. Alternative Four would also designate presently undisturbed lands to the north within the viewshed of Gable Butte and Gable Mountain for Preservation, leaving only the center portion of the Hanford Site with potential to cause disproportionate adverse impacts to American Indians.

Alternative Four would designate most of the Hanford Site for Preservation but would allow for Mining, Research and Development, and Industrial uses. Sufficient area is available to accommodate anticipated future development. Low-income populations in the vicinity of the Hanford Site would benefit from increased economic activity and growth in community services that could occur as a result of development. However, economic development could increase the demand for housing and tend to decrease the availability of low-income housing. In spite of these conflicting impacts, low-income populations in communities that are influenced by development at the Hanford Site would probably benefit from the development. Low-income communities located

to the north and west of the Hanford Site historically have not been strongly influenced by Hanford Site activities and the effects of future development would probably be neutral in these communities.

Designating the Wahluke Slope for Preservation would potentially impact low-income and minority populations located to the north of the Hanford Site by limiting the potential for new jobs in those areas. In general, lands on the Wahluke Slope are not presently available for agricultural development and many jobs associated with agricultural practices are relatively dangerous and not high wage opportunities. Consequently, the Preservation designation for the Wahluke Slope would be unlikely to result in disproportionately high and adverse impacts to low-income or minority populations.

5.5 Human Health Risk

The alternatives being considered in this EIS were developed with the assumption that human health risk associated with contamination at the Hanford Site will continue to be addressed through the RCRA and CERCLA processes. These processes are expected to reduce human health risk to acceptable levels through remedial actions and administrative controls, such as deed restrictions, which are imposed by CERCLA Records of Decision (RODs). The DOE has also assumed that future land uses would not be allowed until remediation has reduced human health risk to levels acceptable for the intended land use.

Even though ongoing remedial actions at the Hanford Site are expected to reduce human health risks to acceptable levels, health risk from residual contamination could affect future land users at the Hanford Site. Continued migration of contaminant plumes in groundwater could increase future risk levels in down-gradient areas that had previously been remediated to acceptable risk levels. The Draft HRA-EIS (DOE 1996) addressed human health risk to future populations by evaluating four exposure scenarios: residential, agricultural, industrial, and recreational. The risk assessment evaluated the No-Action unrestricted-use alternative, which involved cleanup to annual risk levels less than 1 in 1,000,000 (10^{-6}), two restricted-use alternatives, and the exclusive-use alternative, which involved reducing annual risk levels to less than 1 in 10,000 (10^{-4}).

The Hanford Site has an average annual accident fatality rate that has ranged from 4.9 (1994) to 2.8 (1997) per 100,000 workers. The national average annual accident fatality rate for private industry in 1996 was 5.1 per 100,000 workers (Table 5-13) and Hanford was 4.3 per 100,000 workers. The transfer jobs from the government to the private sector statistically doubles the annual accident fatality risk for the average worker in 1997. Some comparisons can be made regarding occupational health risks among the land-use designations using statistics from the U.S. Bureau of Labor Statistics (Table 5-13). The data in Table 5-13 indicate that the riskiest occupation is logging with an annual fatality rate of 157.3 per 100,000 workers (equivalent to a 10^{-3} risk). Industrial activities associated with Industrial, Industrial Exclusive, and Research and Development have fatal accident annual rates that vary from administrative support operations at 0.5 fatalities per 100,000 workers to, 4.1 fatalities per 100,000 workers for food manufacturing workers, to 20.8 fatalities per 100,000 workers for trucking and warehousing workers. The land-use designations of Preservation, Conservation (Mining), Conservation (Mining and Grazing), Low-Intensity Recreation, High-Intensity Recreation have a different set of occupational hazards associated with recreational activities. Fishing, hunting and trapping are very risky occupations (second to logging) with an annual fatality rate of 137.7 fatalities per 100,000 workers. For sand and gravel mining operations, excavating and loading machine operators annually have 28.3 fatalities per 100,000 workers. The Agriculture land-use designation would expose workers to occupational fatality annual rates of 31.3 fatalities per 100,000 workers for crop production, 12.2 fatalities per 100,000 workers for livestock production and 14.3 fatalities per 100,000 workers for agricultural services (Table 5-13).

Increased recreational opportunities associated with the Preferred Alternative and Alternatives One, Three, and Four could increase accident risks associated with outdoor recreation activities. These would include risks from boating and swimming accidents, hunting and target shooting accidents, and bicycling accidents. Alternative Three would introduce the relatively risky occupation of agriculture onto the Hanford Site. The DOE Preferred Alternative and Alternative Three would best support the selection of some of the occupationally safer uses of the Hanford Site such as manufacturing, managerial and administrative support functions.

5.6 Cumulative Impacts

This section summarizes potential cumulative impacts associated with Hanford Site land-use designations for each alternative identified in Chapter 3. Cumulative impacts result

> *. . . from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).*

Reasonably foreseeable actions are identified and the relationship between these actions and the proposed land-use designations is discussed. The description of potential cumulative impacts couples impacts of each alternative with impacts from past and existing operations at the Hanford Site and impacts that may be associated with anticipated future actions. Section 5.6.1 discusses potential cumulative impacts to land use associated with present and reasonably foreseeable actions; Section 5.6.2 discusses potential cumulative impacts to trustee resources; and Sections 5.6.3 and 5.6.4 discuss potential cumulative socioeconomic impacts and cumulative human health risk, respectively.

5.6.1 Cumulative Impacts to Land Use

The alternatives analyzed in this document would establish acceptable uses for Hanford Site lands for at least the next 50 years. The alternative identified and selected for implementation in the ROD would allocate lands for use under the defined land-use designations. Other present and reasonably foreseeable actions at the Hanford Site that involve siting new facilities or using Site resources also would, in effect, allocate lands for certain uses. Those present and reasonably foreseeable actions that involve land uses that are compatible with the proposed land-use designations under all the alternatives would not have cumulative impacts for land use; these actions are listed in Table 5-14 and described further in Appendix E. However, those present and reasonably foreseeable actions that do not conform with the proposed land-use designations would change the land-use allocations and, in this sense, could be considered to have potential cumulative impacts. Those present and reasonably foreseeable actions involving nonconforming uses are listed in Table 5-15.

The five actions listed in Table 5-15 could involve land uses that conflict with land-use designations under some alternatives. The USFWS is initiating a Comprehensive Conservation Plan (CCP) for the ALE Reserve. Assuming that the USFWS management plan would call for maintaining the ALE Reserve in its present, Preservation and Conservation type of management, the management plan would not conflict with any of the proposed land-use designations. If the USFWS plan only addresses preservation, then the proposed mining alternative on ALE, in lieu of the McGee Ranch mining area, would be in conflict with alternatives, Preferred, Four and Three.

A similar situation exists with the alternative selected in the ROD for the Hanford Reach (NPS 1996), which calls for designating the Wahluke Slope as an overlay wildlife refuge and designating the Columbia River Corridor on the Hanford Site (i.e., the Hanford Reach) as a Wild and Scenic Recreational River. These designations could result in the management of the Wahluke Slope

Table 5-14. Present or Reasonably Foreseeable Future Actions Compatible with Land-Use Designations under All Alternatives.

Present or Reasonably Foreseeable Future Action	Location	Land Use
Wild and Scenic River Designation for Hanford Reach	Hanford Reach	Preservation
Decommissioning of Eight Surplus Production Reactors	200 Areas (disposal)	Industrial-Exclusive
Deactivation of the N Reactor	200 Areas (disposal)	Industrial-Exclusive
Safe Interim Storage of Hanford Tank Wastes	200 Areas	Industrial-Exclusive
Tank Waste Remediation System	200 Areas	Industrial-Exclusive
Plutonium Finishing Plant Stabilization	200 Areas	Industrial-Exclusive
Decommissioning of Building 232-Z and Building 233-S	200 Areas	Industrial-Exclusive
Environmental Restoration Disposal Facility Expansion	200 Areas	Industrial-Exclusive
Spent Nuclear Fuel Management (current and projected)	200 Areas	Industrial-Exclusive
200 Area Effluent Treatment Facility	200 Areas	Industrial-Exclusive
Operation of 200 Areas LLW Burial Grounds	200 Areas	Industrial-Exclusive
Operation of U.S. Ecology Commercial LLW Burial Ground	200 Areas	Industrial-Exclusive
Solid Waste Retrieval Complex, Enhanced Radioactive and Mixed Waste Storage Facility, and Central Waste Support Complex	200 Areas	Industrial-Exclusive
Tank 241-C-106 Sluicing and Waste Removal	200 Areas	Industrial-Exclusive
Special Case Waste Storage Facility	200 Areas	Industrial-Exclusive
Disposal of Decommissioned Naval Reactor Plants	200 Areas	Industrial-Exclusive
Environmental Molecular Sciences Laboratory	300 Area	Industrial, Research & Development (R&D)
Disposition of Sodium Test Loops	200 Areas, 300 Area	Industrial-Exclusive, Industrial, R&D
Fast Flux Test Facility	400 Area	Industrial, R&D
Disposal of S3G and D1G Prototype Reactor Plants	200 Areas	Industrial-Exclusive
Hanford Solid Waste EIS	200 Areas	Industrial-Exclusive
Offsite Thermal Treatment of Low-Level Mixed Waste	200 Areas, City of Richland	Industrial-Exclusive, Industrial, R&D
200 Area Emergency Facilities Campus	200 Areas	Industrial-Exclusive
300 Area Steam Replacement	300 Area	Industrial, R&D
Lead Test Assembly Irradiation and Analysis	200 Areas, 300 Area	Industrial-Exclusive, Industrial, R&D
Management of Hanford Site Non-Defense Production Reactor Spent Nuclear Fuel	200 Areas	Industrial-Exclusive
Relocation and Storage of Sealed Isotopic Heat Sources	200 Areas	Industrial-Exclusive
Trench 33 and 36 Widening in 218-W-5 LLW Burial Ground	200 Areas	Industrial-Exclusive
Idaho High Level Waste and Facility Disposition Environmental Impact Statement (DOE/EIS-0287)	200 Areas	Industrial-Exclusive
Implementation of Final Waste Management Programmatic EIS (DOE/EIS-0200) RODs	200 Areas	Industrial-Exclusive
Expansion of the Energy Northwest (formerly known as WPPSS) area industrial facilities (natural gas fired electric generator turbine or aluminum smelter)	600 Area	Industrial, R&D

Table 5-15. Present or Reasonably Foreseeable Future Actions with Nonconforming Land Uses.

Present or Reasonably Foreseeable Future Action	Nonconforming Land-Use Designations T = nonconforming					
	No-Action	**Preferred Alternative**	**Alternative One**	**Alternative Two**	**Alternative Three**	**Alternative Four**
Development of a Comprehensive Conservation Plan for the ALE Reserve by the USFWS **(Preservation)**	N/A	**T Conservation (Mining)**			**T Conservation (Mining)**	**T Conservation (Mining)**
Designation of the Wahluke Slope as a National Wildlife Refuge **(Preservation)**	N/A				**T Agriculture**	
Operation of the Laser Interferometer Gravitational Wave Observatory **(Research and Development)**	N/A	**T Conservation (Mining)**	**T Conservation (Mining)**		**T Conservation (Mining)**	**T Conservation (Mining)**
Inert/Demolition Waste Landfill (Pit 9) **(Industrial)**	N/A		**T Preservation**	**T Preservation**		**T Preservation**
B-Reactor Museum **(High-Intensity Recreation)**	N/A					**T Preservation**

and the Columbia River Corridor as Preservation, Conservation or Agriculture depending on the USFWS's CCP and intent for establishing the refuge. The management of the Wahluke Slope as an overlay wildlife refuge could conflict with the Agriculture land-use designation under Alternative Three unless a purpose of establishing the refuge as defined in the USFWS's CCP included sharecropping for wildlife. The need to link agriculture to furthering the purposes of wildlife is the reason agriculture appears as a conflict in Table 5-15. Of the 181 NWRs with farming programs in 1989, 612 km^2 (233 mi^2) of the129 refuges were farmed by permittees who retained a share of the crop in return for costs incurred to farm the land. On the remaining refuges, Service personnel conducted farming operations with government equipment.

The remaining nonconforming uses listed in Table 5-15 involve present or upcoming actions that would conflict with land-use designations. The operation of LIGO would be considered a pre-existing, nonconforming use under Alternative One and Alternative Four, which could require that the LIGO site be restored to the designated use at the end of the facility's life. Operation of LIGO conflicts with Conservation mining designations because of the facility's sensitivity to vibrations. The Inert/Demolition Waste Landfill proposed for Pit 9 involves using an existing gravel pit located north of the 300 Area for disposal of inert and demolition wastes from the 300 Area. This would be classified as an Industrial land use, and would be considered a pre-existing, nonconforming use under Alternative One, Alternative Two, and Alternative Four. The proposed salvage and demolition of the 300 Area Steam Plant calls for obtaining fill from Pit 9 for filling voids and constructing the final cover. The use of Pit 9 for quarrying materials would be a pre-existing, nonconforming use under Alternative One, Alternative Two, and Alternative Four. The B-Reactor Museum would be in conflict with the Preservation designation of Alternative Four. Management and mitigation of these nonconforming land uses would be accomplished through the CLUP policies and implementing procedures as explained in Chapter 6.

5.6.2 Cumulative Impacts by Trustee Resource

5.6.2.1 Geologic Resources. Geologic resources on the Hanford Site include unique features that have been preserved while similar features in the region have been damaged or destroyed by development. Mining of geologic materials would be allowed under all alternatives being considered, except Alternative Two, and could damage or destroy unique geologic features, such as Missoula Floods features and sand dunes. Mining under the No-Action Alternative and

Alternative Three, if permitted by DOE, could also impact basalt outcrops, such as Umtanum Ridge, Gable Mountain, and Gable Butte. Because these features are rare and susceptible to development elsewhere in the region, damage or destruction of these features on the Hanford Site would increase their aesthetic and ecological value offsite, and decrease their availability for scientific study.

Alternative Three would allow development of cultivated agriculture on the Wahluke Slope. Increasing irrigated lands in the vicinity of the White Bluffs would cumulatively increase groundwater recharge in the area and also could result in additional slumping of the White Bluffs. Additional slumping of the White Bluffs would further reduce their aesthetic, historic, and ecological value; would cumulatively increase sedimentation of the Columbia River; and could accelerate riverbank and island erosion. The No-Action Alternative would also allow the WDFW's current management practice of growing crops for wildlife management purposes on the Wahluke Slope as long as the practice is compatible with the USFS's CCP.

5.6.2.2 Water Resources. Water resources on the Hanford Site, including groundwater and surface water, have been impacted by past waste disposal practices at Hanford. Remediation strategies for cleaning up past contamination are designed for current and predicted future hydrologic conditions. Additional development on the Hanford Site could alter hydrologic conditions, disrupt CERCLA ROD conditions, and increase impacts to water quality from contamination.

Industrial development would be allowed under all alternatives being considered and would increase groundwater consumption and alter groundwater hydrology. Changes to groundwater hydrology as a result of aquifer drawdown and discharges to the soil column could alter the rate of the movement of contaminants toward the Columbia River or in any other direction. Groundwater recharge from industrial waste water discharges and collection and infiltration of runoff in quarries could mobilize contaminants in the vadose zone and cumulatively increase contaminant levels in groundwater.

The Preferred Alternative and Alternatives One, Three, and Four would increase recreational use of the Columbia River over existing levels, which would cumulatively increase levels of oil, gas, and engine exhaust discharged to the river; and increase riverbank and island erosion from boat wakes. Unregulated non-point sources associated with industrial development and mining could add to pollutants discharged to the river from upstream sources, resulting in further water quality degradation. Mining and grazing along the Columbia River Corridor, which would be allowed under the No-Action Alternative, would increase sedimentation in the river, with possible cumulative impacts on spawning areas in the Columbia River.

5.6.2.3 Biological Resources. Because the Hanford Site contains much of remaining undisturbed Columbia Basin shrub-steppe habitat, proposed developments of undisturbed areas would result in cumulative impacts to rare plants and animals, unique plant communities, and terrestrial and aquatic ecosystems. In addition, the Hanford Site contains the last unimpounded, nontidal segment of the Columbia River, and further development along the Reach could result in cumulative losses to species and habitats associated with the Hanford Reach. In some cases (e.g., Upper Columbia River spring run chinook salmon (Endangered listed -3/99), Middle Columbia River steelhead (Threatened listed -3/99) and Upper Columbia River steelhead [Endangered listed -8/97]), further losses of habitat could endanger remaining populations.

The Industrial, Research and Development, and Industrial-Exclusive land-use designations would allow industrial development to displace native plant communities and wildlife habitats where the habitats still exist. In addition, ongoing remediation activities, such as the decommissioning of surplus production reactors, would result in further habitat losses. Many of the actions listed in Table 5-14 for the 200 Areas would involve small losses of habitat, but expansion of the Environmental Restoration and Disposal Facility (ERDF) and other future actions in the 200 Areas could involve larger losses, with potential cumulative impacts to shrub-

steppe habitat. Alternatives One and Two would limit potential cumulative impacts in the 200 Areas by reducing the size of the Industrial-Exclusive land-use designation.

The Conservation land-use designations could result in cumulative impacts by allowing commercial livestock grazing and mining. Cumulative impacts from grazing are most likely under the No-Action Alternative, which would allow grazing over the largest area and could result in further losses of regional biodiversity.

Although basalt and sand and gravel quarries are unlikely to have cumulative impacts because they would disturb relatively small areas, large-scale soil mining to support remediation could result in large habitat losses. If permitted by DOE, the potential for cumulative effects from mining are greatest under the No-Action Alternative and Alternative Three, which would allow development of quarry sites at the McGee Ranch. Losses of shrub-steppe habitat in this area could eliminate the remaining segments of the wildlife movement corridor between the Hanford Site and the Yakima Training Center; which are among the last remaining large tracts of shrub-steppe habitat in the region. Mining in the McGee Ranch area would add to habitat fragmentation that has previously taken place in the region as a result of agricultural, residential, and industrial development; and could further reduce regional biodiversity.

Increased recreational use associated with the Wild and Scenic River designation and High- or Low-Intensity Recreation land-use designations under the Preferred Alternative and Alternatives One, Three, and Four could result in cumulative impacts to wildlife and habitats that are not currently accessible by the public under the No-Action Alternative. Recreation designations would increase impacts from boating as well as foot traffic on sensitive plant communities and habitats.

The potential for cumulative impacts to biological resources may best be evaluated by determining the amount of BRMaP Level III and IV resources that could be affected. The BRMaP Level III and IV designations identify the resources that could be most adversely affected by further habitat losses. Alternative Three has the greatest potential to impact Level III and IV resources, primarily because it would allow conversion of native plant communities on the Wahluke Slope to cultivated agriculture. The Preferred Alternative and the No-Action Alternative would have less potential for impacts to BRMaP Level III and IV resources, but are more likely to impact those resources than Alternatives One, Two, or Four. Alternative Two is least likely to have cumulative effects on biological resources, based on the amounts of BRMaP Level III and IV resources that could be impacted by development.

5.6.2.4 Cultural Resources. Regionally, agricultural, industrial, and residential development have damaged or destroyed cultural resources. In addition, construction of dams along the Columbia River has inundated many cultural resources and sites of significance to American Indian Tribes. Cultural resources on the Hanford Site have been preserved by access restrictions for the past 55 years. Preservation of the Hanford Reach as the last free-flowing stretch of Columbia River would also preserve cultural resources associated with the river. Loss of these sites through development of Hanford Site lands could lead to potentially significant impacts on the remaining cultural resources in the region.

The biological resources on the Hanford Site are also important to American Indian Tribes for traditional subsistence uses. In addition, the Hanford Site includes religious sites important to American Indians. American Indian Tribes with ties to the Hanford Site have long advocated the protection of these resources in their efforts to maintain their cultures and traditional life ways. Further losses of these resources could impact American Indian cultures associated with the Hanford Site.

Potential cumulative impacts to cultural resources are most likely to occur along the Columbia River, where cultural resources and traditional American Indian uses are concentrated. The No-Action Alternative has the greatest potential to affect these resources by

allowing mining, grazing, or industrial development in the Columbia River Corridor. The Preferred Alternative and Alternatives One, Three, and Four would increase recreational access to the corridor, which could result in impacts to cultural resources from unauthorized artifact collection, vandalism, and losses to riverbank and island erosion from boat wakes.

Industrial development under any of the alternatives has the potential to disturb archaeological and historic sites. Alternatives One and Two are least likely to result in cumulative impacts because these alternatives would minimize the amount of land designated for Industrial, Research and Development, and Industrial-Exclusive land uses. Ongoing remediation activities and some of the proposed projects listed in Table 5-15 could also have cumulative effects on cultural resources.

Other potential cumulative impacts to American Indian cultures could occur under the No-Action Alternative and Alternative Three which, if permitted by DOE, would allow quarrying on basalt outcrops that are important religious and cultural sites. Alternative Two would designate most of the Hanford Site for Preservation to protect cultural resources and would be least likely to have cumulative impacts.

5.6.2.5 Aesthetic Resources. The large, undeveloped portions of the Hanford Site and features such as the basalt outcrops, Rattlesnake Mountain, the White Bluffs, and the Columbia River Corridor have aesthetic values that are unique to the region. Industrial development associated with past Hanford operations has altered some viewsheds. Future development of Hanford Site lands could further alter viewsheds and reduce the aesthetic value by increasing airborne particulate, odors, or other pollutants.

The potential for cumulative impacts to viewsheds would be greatest under the No-Action Alternative, which would allow development of Hanford Site lands on a project-by-project basis. This alternative is more likely to result in the siting and construction of industrial developments in previously undisturbed viewsheds. Alternative Three could also have cumulative impacts to viewsheds by allowing, if permitted by DOE, quarrying on basalt outcrops, the conversion of native plant communities on the Wahluke Slope to crop land and orchards, and development of High-Intensity Recreational facilities adjacent to the Columbia River Corridor. Future industrial development under the Industrial-Exclusive land-use designation, along with proposed and planned actions listed in Table 5-14, would have cumulative effects on viewsheds that would be similar under the alternatives being considered.

Alternative Three also has the greatest potential for cumulative impacts on visibility associated with air quality. The conversion of much of the Wahluke Slope to agriculture would create a significant new source of fugitive dust from cultivated fields. Industrial development under this alternative as well as all other alternatives being considered could also result in new sources of industrial pollutants, which could further diminish visibility.

Future development could also increase ambient noise levels, which would detract from the recreational experience associated with the Columbia River Corridor and other natural areas on the Hanford Site. Cumulative increases in noise are most likely occur under the No-Action Alternative, which could allow industrial development along the Columbia River. Mining along the river corridor, which could occur under the No-Action Alternative, could also increase noise impacts. Increases in High-Intensity Recreational land-use activities such as Alternative Three's proposed destination resort and RV camps or the Preferred Alternative's and Alternative Four's proposed Tribal fishing camps, could also increase the noise along the river and distract from the aesthetic experience.

5.6.3 Cumulative Socioeconomic Impacts

The economy of the area has in the past been strongly influenced by Hanford Site activities. Changes in the Site mission and reductions in Site activities have had negative impacts in the past. Recently, the area economy has become more diversified and less dependent on the Hanford Site. Future development of Hanford Site lands under multiple uses could accelerate the transition to a diversified economy. On the other hand, economic growth associated with future uses of the Hanford Site could cumulatively increase demand for infrastructure and services.

Alternative Three has the greatest potential to have cumulative impacts, both positive and negative, on socioeconomic conditions. On the positive side, Alternative Three would provide the most opportunities to develop alternate uses of Hanford Site lands, maximizing the economic return. Alternative Three could have negative impacts on socioeconomic conditions by increasing the demand for services, including schools, law enforcement, and health and human services. Alternative Two has the least potential to have cumulative socioeconomic impacts because it would minimize future Hanford Site development.

As was discussed in Section 5.3.1, future industrial development on Hanford Site lands could place increased demand on infrastructure beyond the City of Richland's capacity. This potentially cumulative impact could occur under the Preferred Alternative and Alternatives Three and Four because they have Industrial land-use designations larger than the City of Richland UGA. However, the impact would be the most under the No-Action Alternative, because no land-use plan would be available to assist government entities in anticipating and addressing increased demand.

5.6.4 Cumulative Human Health Risk

Risks due to exposure to residual contamination remaining after completion of CERCLA activities would be dependent on the level of access to any particular area where residual contamination remained. New wastes could be imported for disposal as specified in the RODs for the *Waste Management Programmatic Environmental Impact Statement* (DOE/EIS-0200, May 1997). Health risks from the new wastes would be principally to workers and could include physical hazards and latent cancer fatalities from waste management activities over the 20-year period of waste movements analyzed. Collective worker health risk estimates for the potential new wastes are one fatality for Low-Level Mixed Waste, three fatalities for High-Level Waste, and up to four fatalities for Low-Level Waste, depending on whether Hanford is selected as a Low-Level Waste disposal site. Less than one latent cancer fatality is estimated among the offsite population. These proposed waste management activities could greatly increase waste shipments entering or leaving the site.

Consequently, the cumulative health risk to humans would be expected to be greatest under Alternative Three because it would provide greater access to more areas and would provide more opportunities for development of Hanford Site lands than would the other alternatives. Conversely, Alternative Two would have the least potential for cumulative human health risks, because it would provide the least access to Hanford Site lands.

Significant occupational risk to workers could occur under some industrial uses, under both the Industrial-Exclusive and Industrial land-use designations. Agriculture is also traditionally a high risk occupation (Table 5-13). Cumulative occupational risk would likely be the greatest under Alternative Three because of the large area designated for Agriculture and the higher level of use associated with the entire Hanford Site. Conversely, occupational risk would be lowest

for Alternative Two because industrial risk would be limited to workers in the 200 Areas (similar under all alternatives) and Alternative Two designates the smallest area for Industrial development.

5.7 Other NEPA Considerations

NEPA is used by the Executive Branch through Executive Orders to further the administration's goals in several policy areas. NEPA integration requires the presentation of many diverse subject areas to ensure that the Federal decision maker is fully informed.

5.7.1 Unavoidable Adverse Impacts

The potential unavoidable adverse impacts associated with implementation of future land uses on the Hanford Site are described in the following section. Unavoidable adverse impacts are impacts that would occur after implementation of all feasible mitigation measures. Although these impacts would not occur as a result of adoption of any particular land-use plan, unavoidable adverse impacts would occur as a result of development of undisturbed land for other uses. The greatest potential for unavoidable adverse impacts is associated with more intensive land uses and the areal extent of those uses in each alternative. These impacts would be associated with the degree of disturbance of sensitive habitats and loss of cultural resources.

Land-use designations with the greatest potential for unavoidable adverse impacts are Agriculture, Industrial, Industrial-Exclusive, and High-Intensity Recreation. Designations with less potential for unavoidable impacts (but that would likely include some unavoidable adverse effects on resources) include Research and Development, Low-Intensity Recreation, Conservation (Mining and Grazing), and Conservation (Mining). Unavoidable adverse impacts would be minimal or nonexistent under the Preservation designation.

The Hanford Site has an abundance of significant cultural resources and conversion of land from the relatively undisturbed condition could result in the loss of significant resources. These resources are considered irreplaceable. The extent of damage to these resources would depend on the extent of the land area converted to intensive uses and the distribution of the resources relative to the location of the disturbance. Some resource locations are more significant than others, and each location must be assessed individually. Mitigation measures, such as data collection, would be implemented but unavoidable adverse impacts associated with destruction of the actual location of resources would occur as a result of some land-use designations.

The Hanford Site also represents one of the last remaining large tracts of the shrub-steppe habitat that previously covered extensive areas in eastern Washington State. Intensive use of these lands could result in the loss of significant amounts of this habitat and could potentially lead to listing (as threatened or endangered) species that are dependent upon this habitat. Although lands converted to other uses potentially could revert to the original state, this reversion is unlikely to occur because the land would remain in the developed condition and reversion would require many years.

Physical impacts on terrestrial resources and sensitive habitats (e.g. aquatic habitat, wetlands, shrub-steppe habitat) would be unavoidable under some land-use designations. Permanent loss of habitat for some species of concern could occur and could result in population declines. Habitat loss within the 200 Areas would likely be unavoidable, but these losses are anticipated to be similar under all alternatives. The magnitude of potential physical

impacts across other areas on the Hanford Site depends upon the land-use designations associated with particular alternatives.

The Agriculture land-use designation has the greatest potential for unavoidable adverse impacts. Destruction of cultural resource sites, both on the land converted to this use (and, potentially, as a result of increased slumping of the White Bluffs if uncontrolled irrigated agriculture occurs on the Wahluke Slope), would be unavoidable under this designation. Shrub-steppe habitat in areas converted to agricultural use would be lost. Depending on the area of land converted to agriculture, mitigation of habitat loss would not be feasible.

Industrial, Research and Development, and High-Intensity Recreation land-use designations could result in unavoidable adverse impacts to cultural resources and sensitive habitats. The degree of impact would depend on the extent of development. Siting of specific industrial facilities could be modified to minimize impacts. Nevertheless, if large portions of areas designated for Industrial use are ultimately used, cultural and biological resources within the areas would be lost. Similarly, development of High-Intensity Recreational facilities (e.g., golf courses) or R&D facilities could involve loss of or damage to resources.

Other potential unavoidable adverse impacts would be associated with grazing of livestock (resulting in damage to habitats that are sensitive to grazing or physical damage of cultural resources), inadvertent or deliberate damage to cultural resources due to increased exposure of resources to humans, and localized damage to resources due to mining activities.

Implementation of Alternative Three would involve the greatest potential for unavoidable adverse impacts. These impacts would be associated with loss of cultural and biological resources due to conversion of extensive areas on the Wahluke Slope to agriculture and with the area designated for Industrial use, and Research and Development. Alternative Three also includes the greatest extent of land designated for Recreational uses.

The Preferred Alternative also could potentially lead to unavoidable adverse impacts associated with lands designated for Industrial Use, Research and Development, and Conservation (Mining). Although impacts associated with other land-use designations could potentially be mitigated, Industrial and Research and Development uses would likely lead to unavoidable adverse impacts to some cultural and biological resources.

Implementation of Alternative Two would have the least potential for unavoidable adverse impacts. This alternative designates virtually the entire Hanford Site for Preservation. Areas designated for other uses occur largely in previously disturbed areas. Unavoidable adverse impacts under this alternative would be minimal and would be associated with Industrial-Exclusive use of the 200 Areas (similar under all alternatives) and with Industrial use in the UGA north of the City of Richland, which is smaller than the area designated for Industrial use under all other alternatives.

Alternatives One and Four represent intermediate conditions between Alternative Two and the Preferred Alternative. Potential unavoidable adverse impacts under the No-Action Alternative could involve development of any portion of the Hanford Site in the future, with the exception that this alternative assumes that management on the Wahluke Slope and ALE Reserve would continue to be similar to current management.

5.7.2 Irreversible and Irretrievable Commitments of Resources

The identification of irreversible and irretrievable (I&I) commitments of resources associated with actions proposed by Federal agencies is required by NEPA. On land-use projects, I&I commitments are related to the use of nonrenewable resources and the effects that consumption of those resources could have on future generations. For example, irreversible

effects occur as a result of use or destruction of a resource (i.e., energy and minerals) that cannot be replaced within a reasonable time, while irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored (i.e., extinction of a species or disturbance of a cultural site).

The Final HCP EIS does not I&I commit resources to any specific project of the Hanford Site, but does I&I commit natural resources to the land-use designations as allocated by Table 3-1. After incorporating by reference the previous 1975 ERDA 1538 irreversible and irretrievable (I&I) commitments and other documented commitments into this EIS (see Section 1.3), future individual project land-use requirements would be I&I committed through the appropriate NEPA and CERCLA/RCRA/NEPA integrated processes, as described in Chapter 6. Table 3-3 summarizes the commitment of Hanford Site lands, by land-use designation, for each alternative.

5.7.3 Conflicts with Land-Use Plans of Other Federal, Regional, State, Local, and Tribal Agencies

The Draft HRA-EIS CLUP (DOE 1996) identified one vision for the future use of Hanford Site lands. Numerous comments were received by DOE from other agencies, Tribal governments, and stakeholders indicating that a land-use plan for the Hanford Site needed to be developed. These comments indicated that alternative land-use plans needed to be analyzed and compared to the plan presented in the Draft HRA-EIS CLUP, and that DOE needed to identify a Preferred Alternative for future land use at the Hanford Site. As a result of these comments and concerns regarding different visions for the future of Hanford Site lands, DOE initiated a process of coordination and consultation with other Federal, state, and local government agencies, and Tribal governments to develop and analyze potential impacts associated with alternative land-use scenarios for the Hanford Site. The DOE revised the August 1996 Draft HRA-EIS to reflect these concerns and is presenting the impact analysis in this Final HCP EIS.

Existing plans of other Federal, state, and local agencies, and Tribes have been incorporated as alternatives in the Final HCP EIS if those agencies or Tribes elected to provide DOE with a land-use map depicting a vision for the future of Hanford Site lands. The DOE cannot speculate with regard to land-use patterns that might be preferred by agencies or Tribes that did not provide a specific vision for the future of land use at the Hanford Site. Therefore, DOE knows of no existing land-use plans in conflict with the alternatives presented in this Final HCP EIS.

The DOE recognizes the interest of the BoR and the BLM in lands withdrawn from them at the Hanford Site, and acknowledges the U.S. Atomic Energy Commission's agreement to return lands no longer needed for safeguards and security purposes in the Wahluke Slope to the BoR for development as part of the Columbia Basin Project. The DOE also recognizes, as a co-preparing agency, the alternative selected in the ROD for the Hanford Reach EIS (NPS 1994). This alternative would designate the land within the Wahluke Slope as a NWR. The DOE and BLM have discussed consolidation of BLM lands within a specific area of the Hanford Site (Figure 4-3), or exchanging Hanford Public Domain lands for lands elsewhere with natural resources values. The BLM may consider selling land to private entities to allow Industrial, Research and Development, or High-Intensity Recreation uses to occur on BLM's scattered tracts of land if the economic return would fund appropriate environmental mitigation elsewhere. Public comment such as the anti-grazing response received on this EIS will help determine the path forward.

The BLM completes approximately 65 land exchanges per year, acquiring nearly 60,703 ha (150,000 ac) valued over $60,000,000. Current law restricts exchanges to lands located within the same state. In general, the lands must be of equal value, although limited

cash equalization adjustments are allowed. Certain low value exchanges may proceed on the basis of "approximately equal" value.

The exchange of land is authorized under the *Federal Land Policy and Management Act of 1976*, (FLPMA), as amended, and the *Federal Land Exchange Facilitation Act of 1988* (FLEFA). The BLM's final rulemaking implementing FLEFA was published jointly with the U.S. Forest Service in 1993. A final Land Exchange Handbook was completed in 1997 replacing a draft that was in use for over two years.

Land exchange has been identified as a high priority within the DOI as well as BLM. Exchanges provide the opportunity for BLM to acquire lands with high recreational, wildlife habitat, scenic, and cultural resource values. They are also used to consolidate BLM lands into more manageable units and to meet community expansion needs.

Recent accomplishments in this program include the following:

- **Lake Tahoe, Zephyr Cove, Nevada** -- The Federal government acquired 14 ha (35 ac) along Lake Tahoe. The property has nearly 1.6 km (1 mi) of sandy beach, spectacular scenic views, and an opportunity to protect sensitive plant and animal species. The BLM traded approximately 546 ha (1,350 ac) of lands in the Las Vegas Valley for the property. The lands acquired will be managed by the U.S. Forest Service.

- **Lake Fork of the Gunnison River, Colorado** -- The BLM acquired 1,376 ha (3,400 ac) of Smock Ranch (formerly Gateview Ranch) along the Lake Fork of the Gunnison River. The BLM plans to acquire approximately 809 ha (2,000 ac) of the adjacent Thomas Ranch in a second phase. The exchange provides valuable fisheries and recreational resources, and reduces the BLM's management costs by placing 33 small isolated parcels into private ownership.

- **Santa Ana Pueblo, New Mexico** -- Approximately 6,070 ha (15,000 ac) of Federal and state lands were transferred to the Santa Ana Pueblo, resolving a 20-year commitment to eliminate the "checkerboard" land ownership pattern within the Pueblo's boundary. The BLM will receive state lands located in wilderness study areas and other special management areas throughout the state.

- **Clearwater - Phase II, Washington** -- The BLM acquired 364 ha (900 ac) of land including 3.2 km (2 mi) of river frontage adjacent to the Grande Ronde National Wild and Scenic River. The lands have important values for fish and wildlife as well as high recreational value for fishing, hunting, white water boating, hiking, and sightseeing.

5.7.4 Relationship Between Near-Term Use and Long-Term Productivity of the Environment

For the purposes of this Final HCP EIS, near-term use is defined to encompass the 50-year planning period associated with this EIS. Long-term productivity is defined to encompass the period following this planning window.

The DOE anticipates that considerable activity related to ongoing remedial actions will occur at the Hanford Site for the near-term. This activity would likely influence allowable land uses in the near-term. New near-term uses would be consistent with land-use designations adopted in the ROD for this Final HCP EIS, and remedial activities would be anticipated to support those uses and designations.

Although the land-use alternatives analyzed in this Final HCP EIS represent varied viewpoints of the best use of Hanford Site lands within the near-term, the objective of these plans is establishment of a framework for balancing overlapping long-term needs to meet the requirements of DOE missions, community development, recreational opportunities, and resource preservation. Long-term productivity can be enhanced through this process because conflicting viewpoints regarding the best use of Hanford Site land can be objectively analyzed, and the uses to satisfy the various real and perceived needs can be incorporated into long-term planning. Through this planning process, long-term productivity of Hanford Site lands can be enhanced by establishing areas that would be devoted in the short- and long-term for uses ranging from intensive development to preservation.